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THE QUARTERLY BULLETIN

OF THE

STATE PLANT BOARD

OF FLORIDA

VOLUME I
1916-'17

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. I OCTOBER, 1916 No. 1

CITRUS CANKER INVESTIGATIONS

WILMON NEWELL

One of the first steps taken by the State Plant Board upon the passage of the Florida Plant Act of 1915 was to make provision for an exhaustive study of citrus canker with a view to determining whether any remedial measures for this destructive disease of citrus trees might be devised.

The establishment of a special laboratory for these investigations was made possible by the generosity and public spirit of the South Dade County Fruit and Truck Growers' Association. This association erected at Redland, Dade County, a spacious building to be used jointly as an auditorium and a laboratory. For the latter the State Plant Board purchased the necessary equipment and the Tropical Laboratory was formally opened on November 27, 1915, with Dr. R. A. Jehle, Assistant Plant Pathologist, in charge. Considerable difficulty was experienced in getting the necessary laboratory supplies on account of the unsettled European conditions, but good progress in the investigations has nevertheless been made.

It was early recognized that the fruit growers and inspectors should be provided with descriptions and illustrations of citrus canker in order that they might recognize the disease and distinguish it from other diseases attacking citrus, as the first step towards its eradication.

As a result of careful studies of this disease upon various citrus host plants, Dr. Jehle has prepared the article and illustrations which appear upon the following pages. These, it is believed, will be of great interest and value in the fight now being waged against this disease.

Inasmuch as the laboratory was located in south Dade County, many of the specimens selected for purposes of illustration were, in view of the necessity for accurate identification, selected in the adjacent localities. They were, however, typical of canker specimens found from time to time in other sections of the State where citrus canker exists. It was perhaps fortunate that the preparation of these illustrations was among the first work undertaken at the laboratory, for eradication of the disease in that section, thanks to the hearty co-operation of the great majority of growers, has progressed so rapidly that canker-infected trees are now found only by means of the closest and most efficient inspection.

Other investigations under way at the laboratory are expected to yield information which will materially aid in the practical work of eradicating this disease. The results of these investigations will appear in the Quarterly Bulletin as rapidly as they can be completed.

MEANS OF IDENTIFYING CITRUS CANKER

R. A. JEHLE

Citrus canker is one of the most destructive diseases of citrus plants, and if allowed to develop unchecked it threatens to greatly cripple, if not to completely destroy, the citrus industry wherever it occurs, and especially where the climate is warm and moist during part or all of the year. The disease has only been known to science for about three years and, according to all available information, was introduced into the Gulf States from Japan. It is very important for every grower of citrus plants to be familiar with its characteristics so that it may be eradicated as quickly as possible when found.

PLANTS KNOWN TO BE AFFECTED.

Citrus canker has been found on almost all kinds of citrus plants, and it is likely that none of them is immune, altho they vary in their susceptibility. Observations of Berger (1914) seem to indicate that they are susceptible in the following order: grapefruit, *Citrus trifoliata*, Key lime, navel orange, sweet orange, satsuma, tangerine, mandarin, king orange and lemon. Altho the kumquat was at first thought to be immune (Berger, 1914), recent observations have shown that under favorable conditions it is also susceptible. Wolf (1916) states that it has been observed on this host in Louisiana, and Swingle (1915) reports its occurrence on kumquat in Japan. The writer has produced citrus canker on the kumquat and other citrus plants in Florida by inoculating healthy trees with the canker organisms

PLATE I

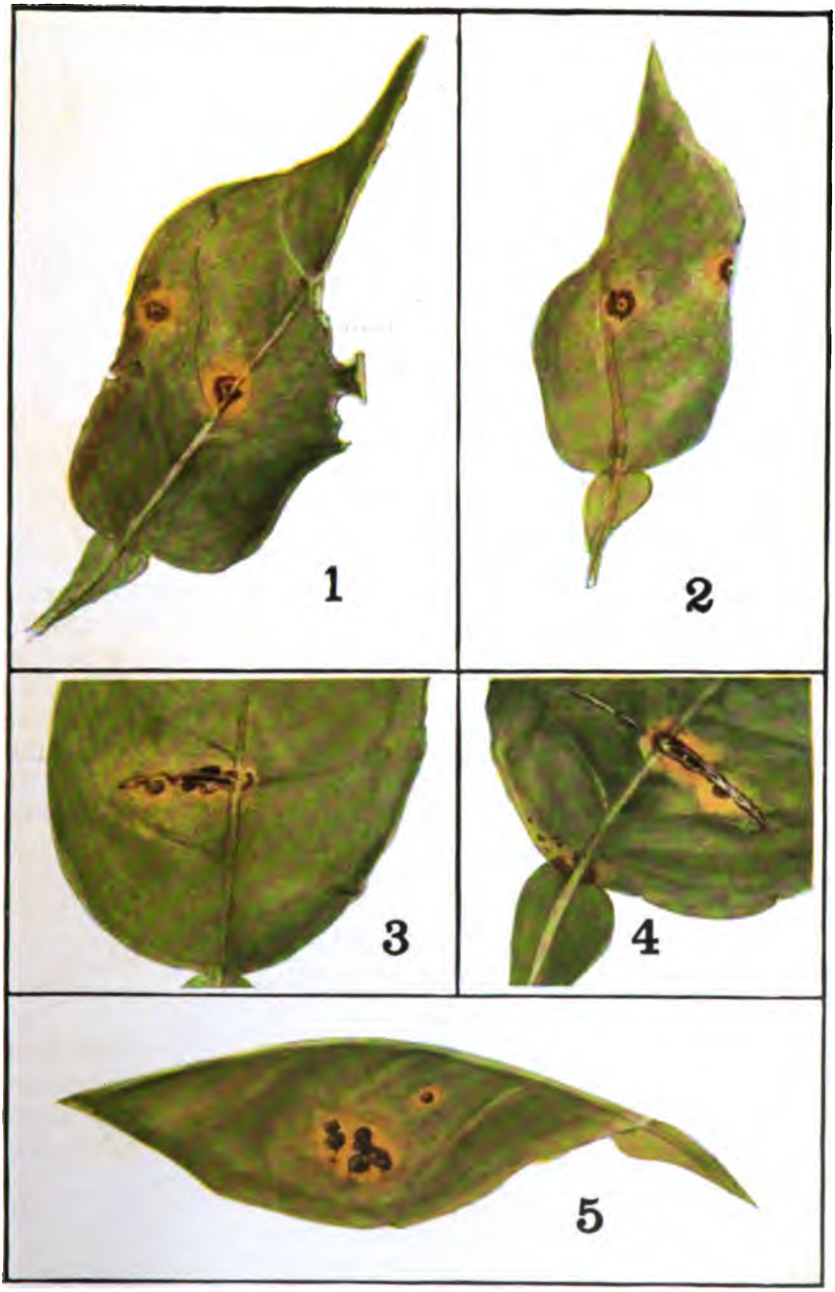


Figure 1. Canker on upper surface of grapefruit leaf. Natural size. Collected in South Dade County. Figure 2. Lower surface. Figure 3. Canker on lower surface of grapefruit leaf along scratch made by a thorn. Natural size. Collected in South Dade County. Figure 4. Upper surface. Figure 5. Young canker on lower surface of grapefruit leaf. Natural size. Collected in South Dade County.

(*Pseudomonas citri* Hasse). The following citrus plants have been infected in this way: grapefruit, tangelo, ponderosa lemon, sour orange, sweet orange, mandarin lime, king orange, and kumquat.

CHARACTERISTICS OF THE DISEASE.

According to Stevens (1915) any part of the plant above ground may become infected. The writer has observed citrus canker on the leaves, young twigs, thorns, older limbs one inch or less in diameter, green fruit and ripe fruit. The older limbs do not seem to be as susceptible as the leaves, twigs and fruit.

ON THE LEAVES.

Medium sized, thrifty leaves seem to be most susceptible, and canker is seldom found on those which are yellowish, unhealthy, very young, or very old. Citrus canker first appears on the leaves as a pimple-like spot which by reflected light has a yellowish-brown, translucent, glazed, oily appearance. By direct light the color is yellow. It may first become visible on either surface, but sooner or later makes its way to the opposite side. When it develops very rapidly, evidences of infection may be observed on both surfaces almost simultaneously. Very young canker infections on the leaves are represented on Plate I, figure 5; Plate X, figure 3; and Plate XII, figure 1. Sooner or later the tissue ruptures in the center of the infected area, giving to the ruptured portion a whitish or pinkish, wartlike, corky appearance. This rupturing may occur on either surface first, or it may occur on both surfaces simultaneously. The ruptured portion is covered by a grayish membrane. The yellowish-brown, glazed, oily, translucent appearance is always present in the outer unruptured zone where the canker organisms are most active, unless this zone is invaded by other organisms. Sometimes the ruptured portion is very large in proportion to the glazed, oily, translucent zone, so that the latter is scarcely visible without the aid of a hand lens. Such spots have a whitish appearance, and are likely to project more prominently than spots where the ruptured portion is proportionately smaller. (Plate XII, figure 1.) The yellowish-brown, glazed, oily, translucent zone is usually surrounded by a yellowish-green zone which shades more or less abruptly into the normal green of the leaf. (Plates I, II, III and IX.) This zone varies greatly in size, and may be almost, if not entirely, lacking. (Plate X, figure 3; Plate XII, figure 1.) As the disease advances the infected area increases in size, and in typical cases the lacerated membrane breaks open in the center, leaving a hole, which gives to the spot a crater-like appearance. (Plate I, figures 1 and 2; Plate II, figures 3 and 4; Plate III, figures 3 and 4.) The spots usually mature when they reach a diameter of a quarter to half an inch. They are typically circular in outline, more or less elevated on both surfaces, and may occur singly or in groups. When in groups they often fuse, forming larger more or less irregular areas. The central portion of the diseased area may drop out, leaving a hole through the leaf. The corky portion is frequently invaded by other organisms which sometimes greatly modify its appearance, often causing it to turn pink or various shades of brown to black. These organisms may grow out into the oily, glazed, translucent zone and modify its appearance, causing it to become cloudy or of a different color than that which is typical of the disease. Spots very similar or almost identical to these may result from other leaf troubles, and it is sometimes almost impossible to tell whether or not there are canker organisms in spots which are not typical, without making cultures from them. In several instances the writer has obtained cultures of the canker organism (*Pseudomonas citri* Hasse) from spots which had been so modified in appearance by other organisms as to be scarcely recognizable as canker, and has produced typical canker infections on apparently healthy trees with these organisms. Any part of the leaf may become infected, and canker is frequently found on the midrib (Plate I, figures 1 and 2; Plate II, figures 3 and 4), along scratches made by thorns (Plate I, figures 3 and 4; Plate X, figure 3) and on the edge of bites made by grasshoppers or other insects (Plate III, figures 1 and 2). When the petiole is infected or when there are canker spots on the leaf, defoliation may occur.

ON THE TWIGS, THORNS AND BRANCHES.

The young tender twigs and thorns are more subject to citrus canker than are the older, more corky ones. The disease first manifests itself on the young twigs as a small, pimple-like, watery, yellowish-brown spot which increases in size as the disease advances. Sooner or later the diseased tissue ruptures, causing it to become corky and of a lighter color. Further rupturing of the tissue may cause the formation of fissures and cracks. The corky portion is more or less covered with a lacerated, grayish membrane and is surrounded by an oily, glazed, transluscent, yellowish-brown zone very similar to that on the

PLATE II

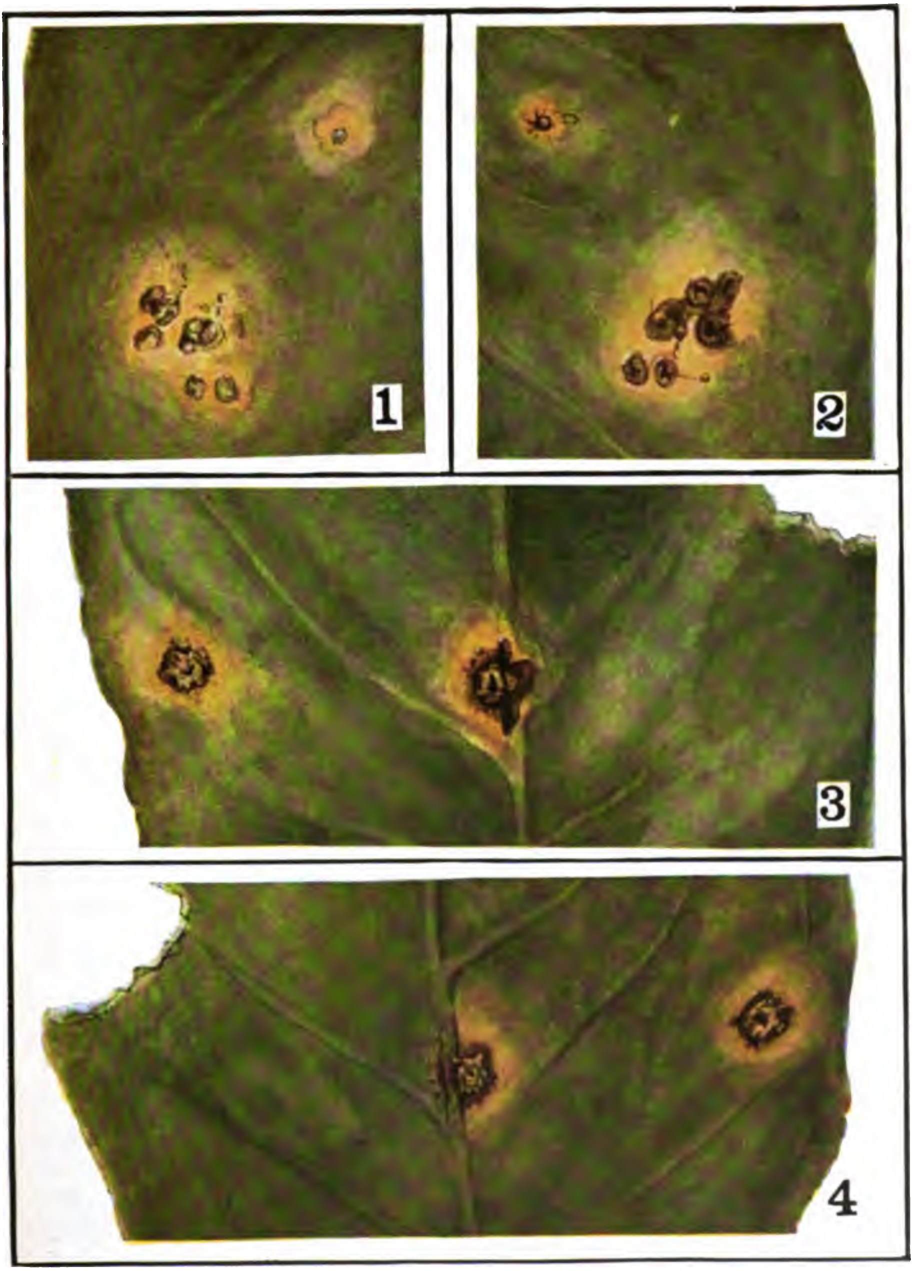


Figure 1. Young canker on lower surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 2. Upper surface. Figure 3. Mature canker on upper surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 4. Lower surface.

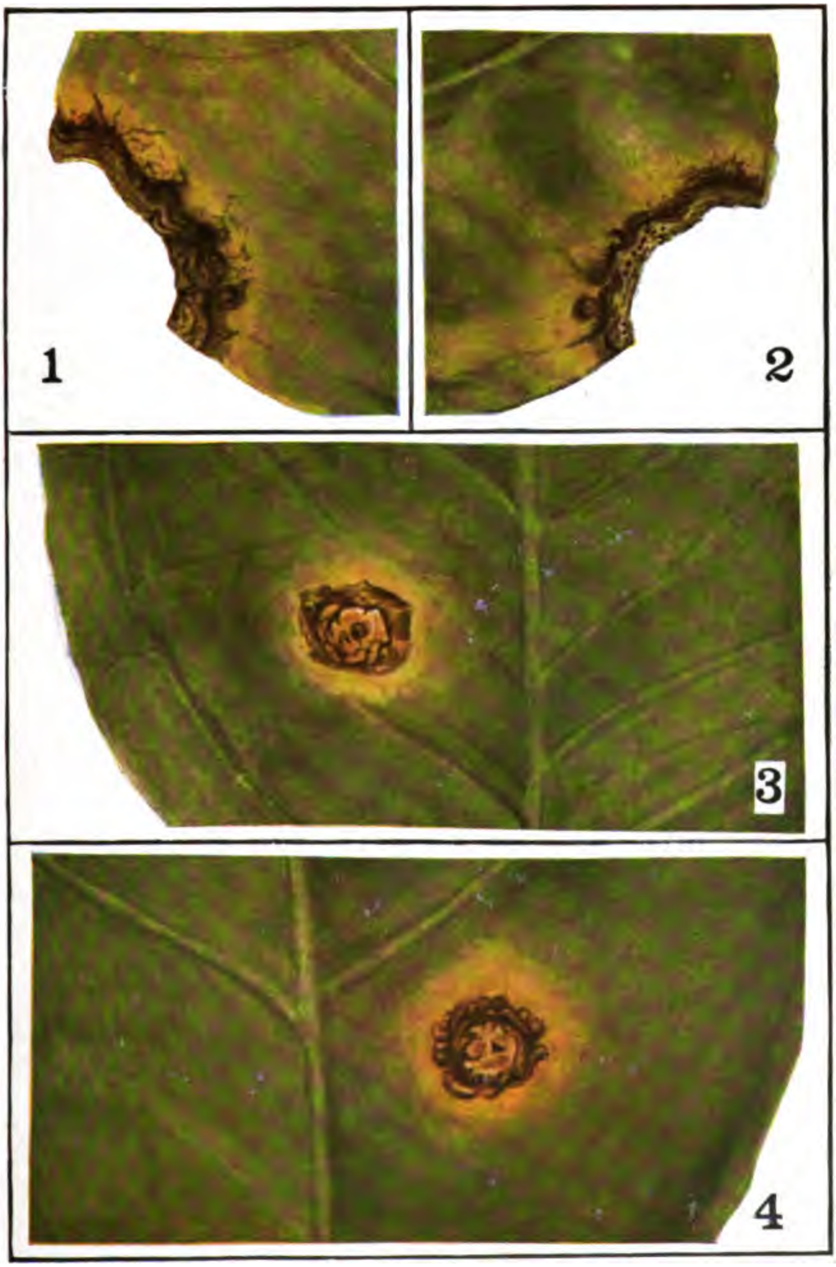


Figure 1. Canker on lower surface of grapefruit leaf along insect bite. Enlarged three diameters. Collected in South Dade County. Figure 2. Upper surface. The black dots are fruiting bodies of a fungus which has attacked the cankered tissue. Figure 3. Mature canker on lower surface of grapefruit leaf. Enlarged three diameters. Collected in South Dade County. Figure 4. Upper surface.

leaf, which shades rather abruptly to the normal green of the twig. (Plate IV; Plate IX, figure 1; Plate XII, figure 1.) The spots mature when they reach a diameter of three-eighths to one-fourth of an inch, and are typically circular and raised with somewhat irregular edges. The corky portion frequently becomes very dark in color, due to the presence of other organisms. Canker infections may occur singly, or they may occur in groups and fuse, causing more or less irregular areas. Sometimes they are so numerous that the twig is girdled. Canker appears the same on thorns as it does on the twigs. On the larger limbs it appears much as it does on the twigs, except that it is somewhat rougher, more prominent, and more or less irregular in shape with complete disappearance of the surface membrane in older spots (Plate X, figures 1 and 4). Canker may mature on the older wood while the spots are still very small, and such canker is often very difficult to find, especially when hidden by fissures and cracks in the bark.

ON THE FRUIT.

As the fruit matures it seems to become less and less susceptible to citrus canker, and mature picked fruit seems to be immune. Ripe picked citrus fruits have been repeatedly inoculated by the writer with canker organisms (*Pseudomonas citri* Hasse), and no canker was ever found on them, altho they were kept in moist chambers in a saturated atmosphere until they were rotted by other organisms. Organisms from the same cultures produced abundant infection of the leaves and twigs of growing citrus plants. Very few small and no immature canker spots have been observed by the writer on mature fruit, while young, immature infections are very numerous on green cankered fruit. As an illustration of this, figure 2 on Plate V may be compared with figure 2 on Plate VI. Very young infections on the fruit appear very similar to those on the twigs and leaves. After the tissue is ruptured the spots become very corky, and large fissures and cracks often appear. (Plate V; Plate VI; Plate VII; Plate VIII; Plate X, figure 2; Plate XII, figures 2 and 3.) The spots may occur singly but are more likely to occur in large number and fuse, causing large diseased areas. Where they are very numerous, gumming may result. (Plate VI, figure 1.) Badly infected fruits may ripen prematurely and fall, but even if they do remain on the trees and mature, they are unsightly and unsalable. The disease itself does not penetrate very deeply into the rind (Plate VI, figure 3), but the cracking and breaking of the skin make conditions favorable for the entrance of other organisms which rot and decay the fruit.

APPEARANCE ON DIFFERENT HOSTS.

Although the symptoms of citrus canker are quite characteristic there are some variations in its appearance on the same host as well as on different hosts. It appears very similar on the leaves of grapefruit, tangelo, sour orange and lemon. On the leaves of the Key lime the color is sometimes darker than on the grapefruit. On orange leaves infections are sometimes slower in becoming visible on both surfaces, and the spots may be much darker in the center than on grapefruit. On the fruit of the orange the spots are likely to be roughened throughout instead of having distinct cracks and fissures as in the case of the grapefruit and tangerine. Canker on the leaves of tangerine and king orange seems to be darker in color than on grapefruit, and the oily, translucent zone has a bluish tinge. Canker on tangerine fruit has deeper and more distinct fissures than on grapefruit, and cracks frequently extend across the entire surface of the spot (Plate XII, figures 2 and 3). The disease has not been observed on fresh tangerine fruit or on satsumas by the writer. Mr. A. L. Swanson states that on tangerine fruit the spots are larger than on grapefruit and considerably darker, especially in the very center of the spot, that this shades off to a gray-green near the edge, and to a distinct green at the very edge. Wolf (1916) describes it on satsumas as follows: "In the case of canker on satsumas, however, there is little or no elevation of the upper surface. Neither is the oily margin so evident on this host, especially in case of old cankers, in which the diseased tissues have become dark brown, simulating the appearance of melanose." The only canker observed by the writer on kumquat was that produced on the leaves and twigs by inoculation with the canker organism. In this case the color was considerably darker than canker on grapefruit. The disease developed very slowly in comparison with other citrus varieties and was very slow in becoming visible on both surfaces of the leaf.

APPEARANCE AT DIFFERENT SEASONS.

Weather conditions and the condition of the host have some effect upon the appearance of citrus canker. The disease does not develop as rapidly in cool, dry weather as it does in warm, damp weather and this probably explains why it appears somewhat different in winter than it does in summer. The main dif-

PLATE IV

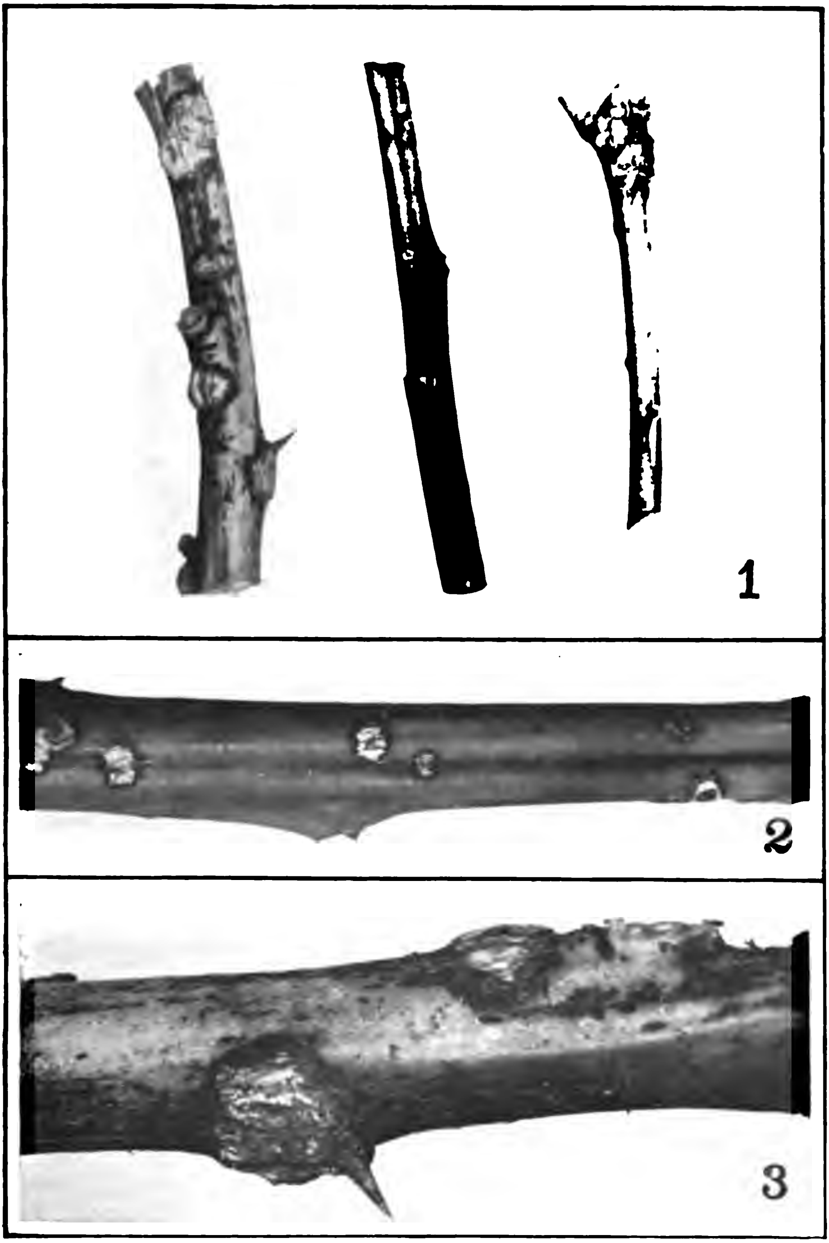


Figure 1. Canker on grapefruit twigs. Natural size. Figure 2. Young canker on grapefruit twig. Enlarged three diameters. Collected in South Dade County. Figure 3. Mature canker on grapefruit twig. Enlarged three diameters.

PLATE V

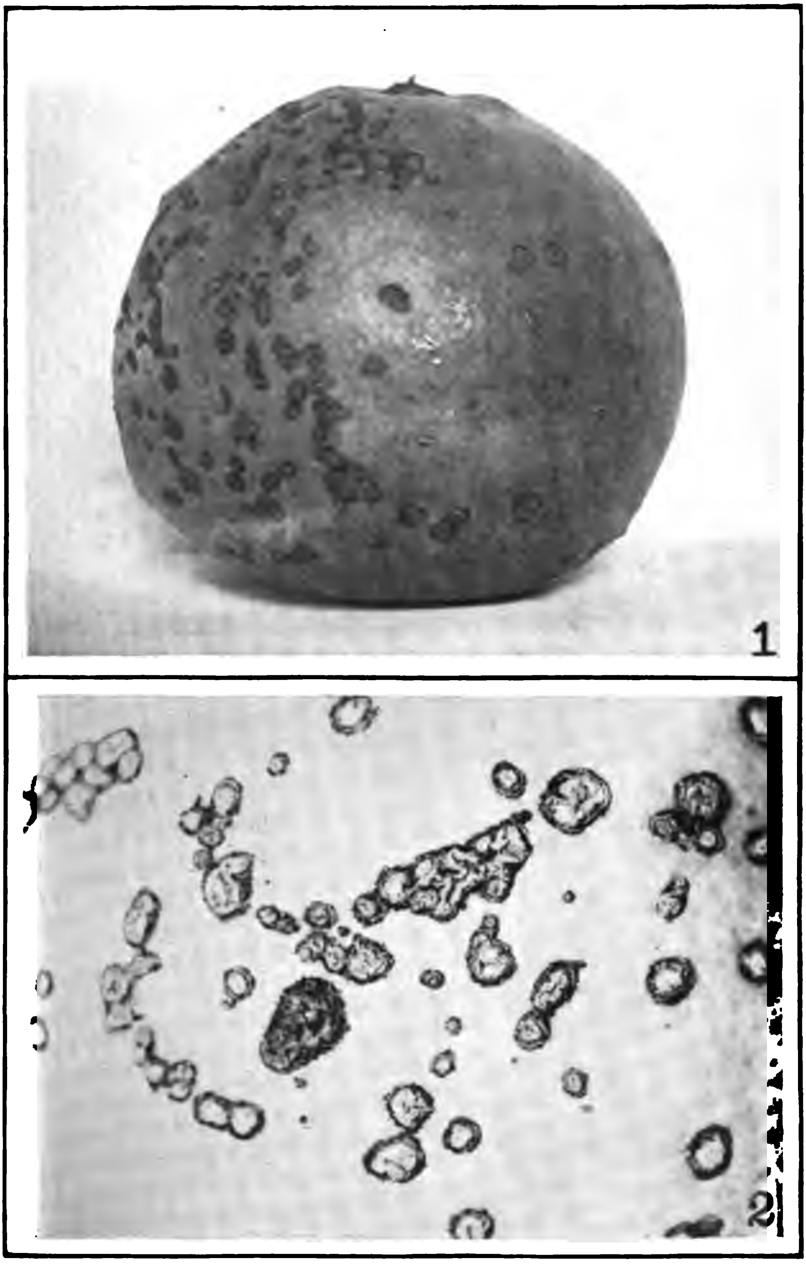
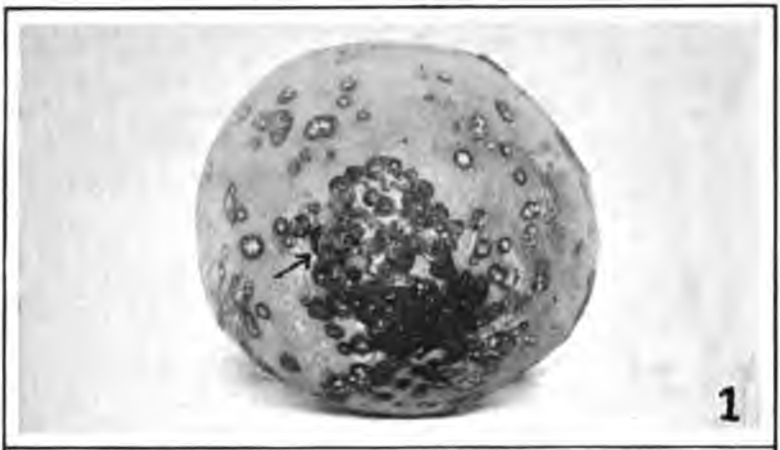


Figure 1. Canker on green grapefruit. Natural size. Collected in South Dade County. Figure 2. A portion of the surface of the grapefruit represented in Figure 1 enlarged three diameters. Note the proportionately large number of immature infections as compared with ripe grapefruit (Plate VI, Figure 2).



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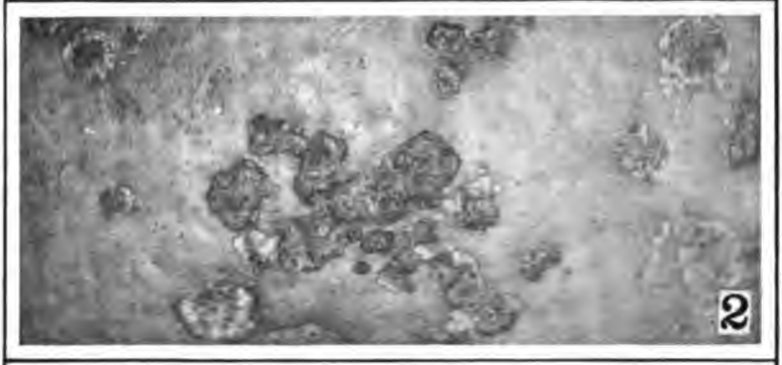

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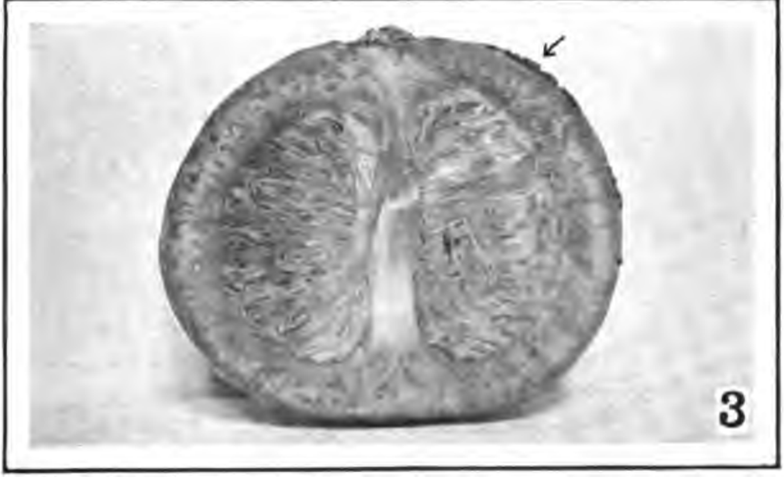

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Figure 1. Green grapefruit badly infected with canker. Natural size. The arrow points to a mass of gum which has exuded from the fruit as a result of the disease. Collected in South Dade County. Figure 2. Portion of the grapefruit represented in Plate VII enlarged three diameters. Note the corky appearance of the infected portion and the comparatively few young infections. Figure 3. Cross-section of a green grapefruit infected with citrus canker. Note that the disease does not penetrate very deeply into the rind, also the raised character of the diseased portion. Natural size.

ference in the appearance of the disease during these seasons is that in winter the spots are likely to be darker in color and the yellowish-green halo is likely to be less prominent or wanting. On hard, yellow leaves canker is always likely to have this appearance.

COMPARISON OF CITRUS CANKER WITH OTHER CITRUS DISEASES.

SCAB. Citrus canker and scab are very similar in appearance during their earlier stages, in fact when canker was first brought to the attention of Berger (Tenny, 1914), it was thought to be an unusual manifestation of citrus scab. In the earlier stages both scab and canker spots may be circular, raised on both surfaces, and have a corky appearance in the center. They may be distinguished by the fact that in canker the outer zone has a watery, oily, translucent, glazed appearance which is lacking in scab. As the diseases advance, the differences between them become more and more marked, and scab distorts the leaves and produces marked wartlike projections on the fruit, whereas these characteristics are wanting in canker.

SCALY BARK. Both scaly bark and canker cause raised, more or less circular lesions, and both cause brown discoloration of the diseased portion, which may be bounded by a yellowish-green zone. They may be distinguished by the fact that in canker there is always a watery, oily, glazed, translucent zone, and the center of the infected area sooner or later becomes more or less spongy, while in scaly bark the spots are hard and glazed throughout.

MELANOSE. Melanose and canker are similar in that they both produce raised spots which during certain stages of their development may be similar in color. They can be distinguished by the fact that the watery, oily, glazed, translucent zone is wanting in melanose, and that in the latter disease the spots are glazed throughout without any central spongy portion. In melanose the color is usually darker and the diseased spots do not, as a rule, penetrate to both surfaces of the leaf. However, when both surfaces are affected, a much smaller affected area is visible on the lower surface, in the case of any one spot. There is usually no yellowish-green halo around the spot in melanose.

GREASY LEAF. This disease resembles canker in causing a spot which is frequently convex on both surfaces of the leaf, may be similar in color, and be broken open in the center. It may be distinguished from canker by the fact that there is no watery, oily, glazed, translucent zone, there is usually no yellowish-green halo. The infected area is usually less regular in outline, and the center of the spot does not have a corky appearance. Greasy leaf does not occur on the fruit or twigs.

ANTHRACNOSE OR WITHERTIP. This disease resembles canker in that both may produce a yellowish-brown spot surrounded by a yellowish-green halo. They may be distinguished by the fact that the watery, oily, glazed, translucent zone is not present in anthracnose, the spots do not have a spongy character, but are hard and glazed, and that anthracnose spots are sunken while canker spots are raised.

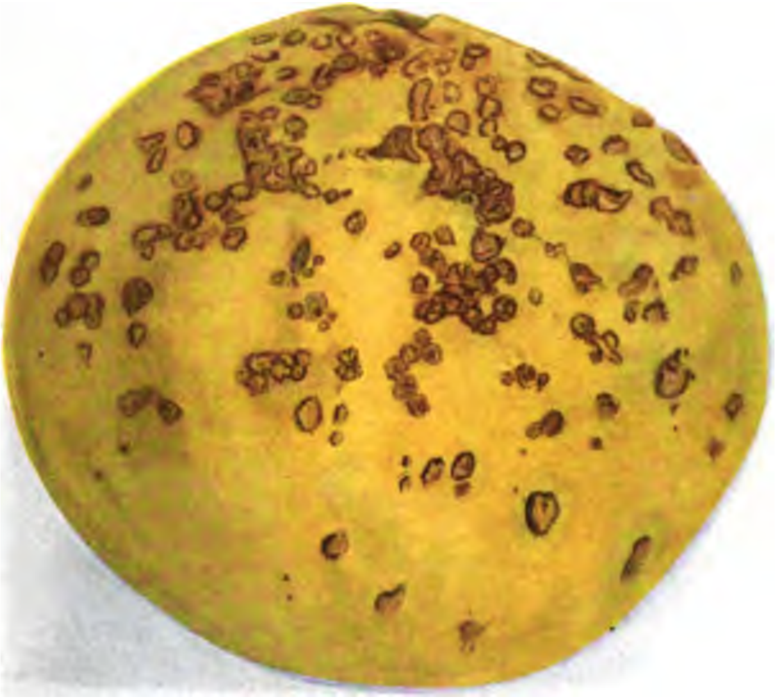
FROST, MECHANICAL AND OTHER INJURIES. Spots which resemble canker are frequently produced on nursery stock by frost or mechanical injuries. They may be circular, have a corky appearance where the tissues have been killed, be brown in color, and may even be somewhat raised. They can usually be distinguished from canker by the absence of the glazed, oily, translucent zone, and by the fact that they are not likely to be as much raised as are canker spots.

Many leaf troubles besides those mentioned may produce spots which resemble canker, but they can usually be distinguished from it by the absence of the oily, glazed, translucent zone. However, in canker spots this zone is sometimes so modified in appearance by the presence of other organisms that it can scarcely be recognized. The presence of the canker organism in such spots can only be determined by waiting for it to develop in a typical form elsewhere on the tree, or by cultural methods.

IMPORTANT POINTS

Citrus canker is spread from tree to tree by any agency which can serve as a carrier for the canker bacteria. Among the agencies responsible for spread of the disease from one tree to another in the same property and from one grove to another in the same locality may be mentioned insects, birds, domestic animals and human beings. Man himself has thus far been the most active agency in this respect. Spread of the disease has been repeatedly, and in the majority of cases, traced to the movement of laborers, fruit-pickers or other workmen from one grove to another.

Dissemination from one locality to another has invariably been by the shipment of nursery stock which was either infected or which had been exposed to infection. As no case of dissemi-



Ripe grapefruit infected with citrus canker. Natural size. Collected in South Dade County.

PLATE VIII

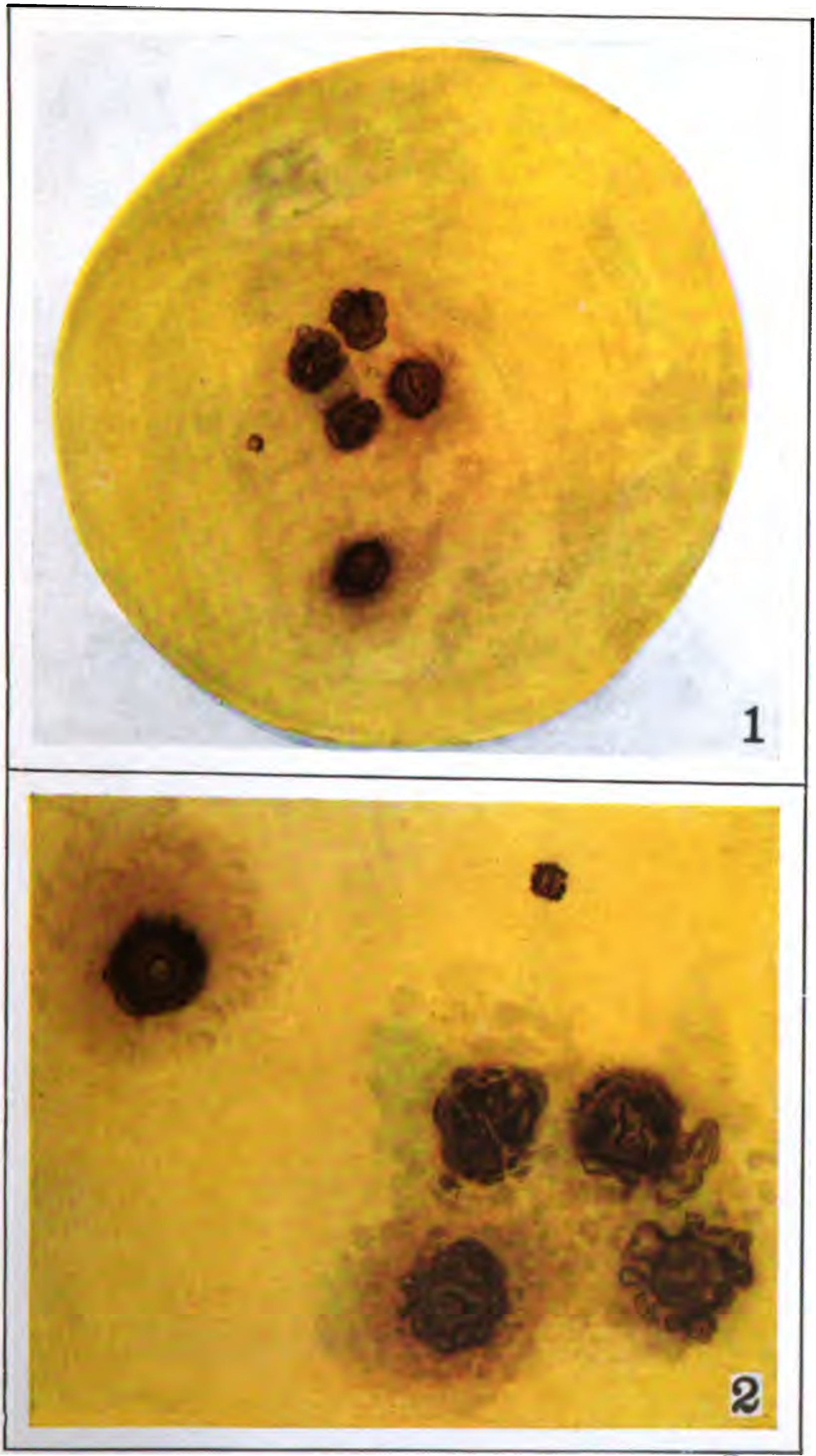


Figure 1. Mature canker on grapefruit. Natural size. Collected in South Dade County. Figure 2. Portion of the fruit represented in Figure 1 enlarged three diameters.

nation of this character is known to have occurred since the enforcement of the present quarantine rules of the Plant Board, it may be safely assumed that dissemination through this means has been effectually stopped.

The disease has a peculiar faculty for lying dormant for long periods without producing any visible symptoms, but sooner or later making its appearance in a typical form. There are numerous instances on record in which it has remained dormant in this way for many months on trees which had been shipped from an infected nursery.

Under certain conditions at least, the canker bacteria can live for long periods in soil which has become inoculated with them. This is readily demonstrated under laboratory conditions by artificially inoculating soil samples with these bacteria. As an experiment in this direction, the writer sprayed a quantity of soil, consisting of equal parts of glade and red soil, with water containing canker organisms. Forty-seven days later a decoction was made from this soil and sprayed onto grapefruit seedlings, with the result that the latter developed typical canker infections. Stevens (1915) has demonstrated that the canker organisms can live and multiply in sterile soil for a long period.

Under field conditions soil becomes infected with the organisms from infected trees, hence the importance of prompt destruction of all infected trees that are discovered in order to avoid soil infection.

Citrus canker develops more rapidly on trees which are in a thrifty, healthy, growing condition than it does on those which are semi-dormant, unthrifty or unhealthy. Trees in a neglected condition may harbor the disease for months before it becomes conspicuous enough to be recognized. In the meantime such trees may continue as sources of infection for other citrus properties.

As the bacteria which cause the disease may be carried upon hands, clothing, tools, etc., the grower finding suspicious-looking spots upon the leaves, twigs, branches or fruit of his citrus trees should immediately stop all cultivation and other work in the entire grove, keep all live-stock (poultry included) out of the property and report the case to the Plant Commissioner, Gainesville, Fla., in order that the case may be investigated by skilled inspectors who know how to deal with such cases under suitable sanitary precautions. The grower should not make the mistake of handling leaves on the trees, picking samples to show others or inviting other people into the property, for if the material under suspicion is citrus canker such measures will distribute it to other trees and groves in the community.

As a general precaution citrus groves, even in localities many miles removed from where canker has been found, should be securely fenced and posted against all trespassing. Laborers should not be employed without a complete disinfection of their clothing and persons being required before they are allowed to enter citrus properties. The same requirement could, with propriety, be applied to visitors, fruit buyers and others whose recent whereabouts are unknown to the grove owner. There is a growing disposition on the part of leading growers to do all work in citrus properties under the same sanitary precautions that are employed by the State Plant Board inspectors.

ACKNOWLEDGMENTS.

The writer wishes to acknowledge his indebtedness to Messrs. Wilmon Newell, K. F. Kellerman, W. J. Krome, Joy Heck and A. M. Henry for many helpful suggestions; to Frank Stirling for the loan of preserved citrus canker specimens; to A. M. Henry and A. L. Swanson for assistance in collection and preservation of specimens of citrus canker and other diseases, and for valuable descriptions of citrus canker on different host plants.

The plates for this bulletin were made from photographs taken by the writer at the Tropical Laboratory, Redland, Florida. All of the photographs were made from fresh specimens excepting those represented in figures 1, 2 and 3 on Plate IV; figures 1 and 2 on Plate V; figures 1 and 3 on Plate VI; figures 1, 2 and 4 on Plate X; figures 1 and 4 on Plate XI; and figures 2 and 3 on Plate XII, which were made from preserved material. The colored plates were made from copies of the photographs painted in water color from fresh material by Mrs. A. M. Blakesley, Redland, Florida.

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PLATE IX

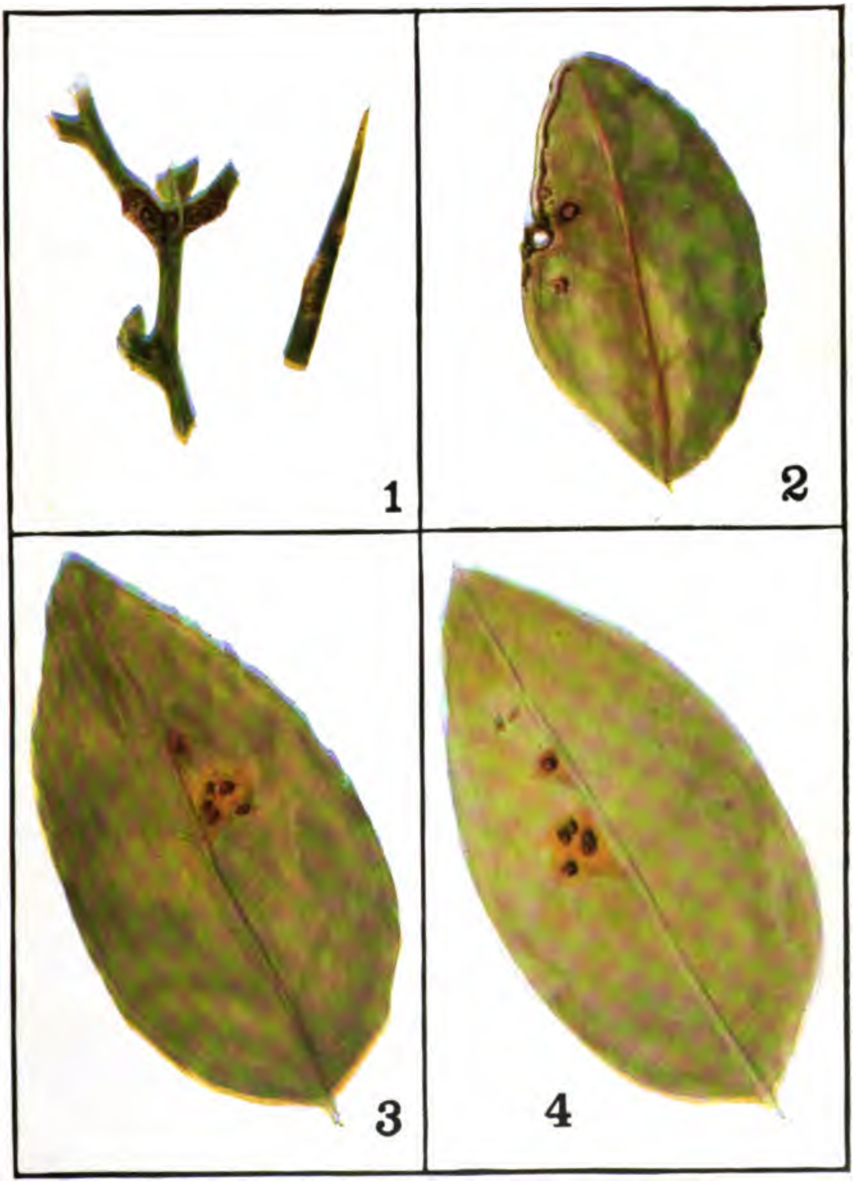


Figure 1. Canker on twig and thorn of lime. Natural size. Collected in South Dade County. Figure 2. Canker on under surface of lime leaf. Natural size. Collected in South Dade County. Figure 3. Very young canker on upper surface of lime leaf. Natural size. Collected in South Dade County. Figure 4. Lower surface.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* .... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER	*Entomologist*
F. M. O'BYRNE	*Nursery Inspector*
R. A. JEHLE	*Asst. Plant Pathologist*
FRANK STIRLING	*General Inspector*

Application for entry as second-class matter at the postoffice at Gainesville, Florida, pending.

THE QUARTERLY BULLETIN. In presenting this, the first number of the "Bulletin," to the farmers and fruit growers of Florida, we frankly confess to having modeled it after that most excellent journal, "The Monthly Bulletin," published by the California State Commission of Horticulture.

For nearly five years the Monthly Bulletin has carried its messages to the fruit growers and citizens of California, keeping them informed regarding the latest horticultural methods, the best means of fighting insect pests and diseases and current information regarding the efficient quarantine system which has kept so many destructive insects and plant diseases out of that State. Its numbers are in demand wherever fruit is grown, both in the United States and foreign countries, and it has attained the enviable position of being one of the foremost publications devoted to the practical application of scientific knowledge. In launching a Florida publication intended to serve a somewhat similar purpose we have elected to follow a good example rather than to try experiments in the—to us—uncharted sea of "journalism."

In brief, the object of the Quarterly Bulletin will be to provide the farmers and fruit growers of this State with the information contemplated by the Florida Plant Act of 1915. This will include, from time to time, reports upon the progress of eradicating citrus canker from Florida and upon the port and railway inspection service now being maintained by the State Plant Board to prevent the introduction of any more destructive diseases, information concerning the nursery inspection work and timely articles upon insect pests and diseases. Rules and regulations of the State Plant Board will also be published, with explanations as to the necessity for them, and their application under varying circumstances.

The Quarterly Bulletin will not attempt to enter the general fields of agriculture and horticulture. As the State Plant Board was charged by legislative act with preventing the introduction and dissemination of insect pests and diseases injurious to plants and plant products and with devising and promulgating means for their eradication or control, so must its official publication be devoted to the same objects.

PLATE X

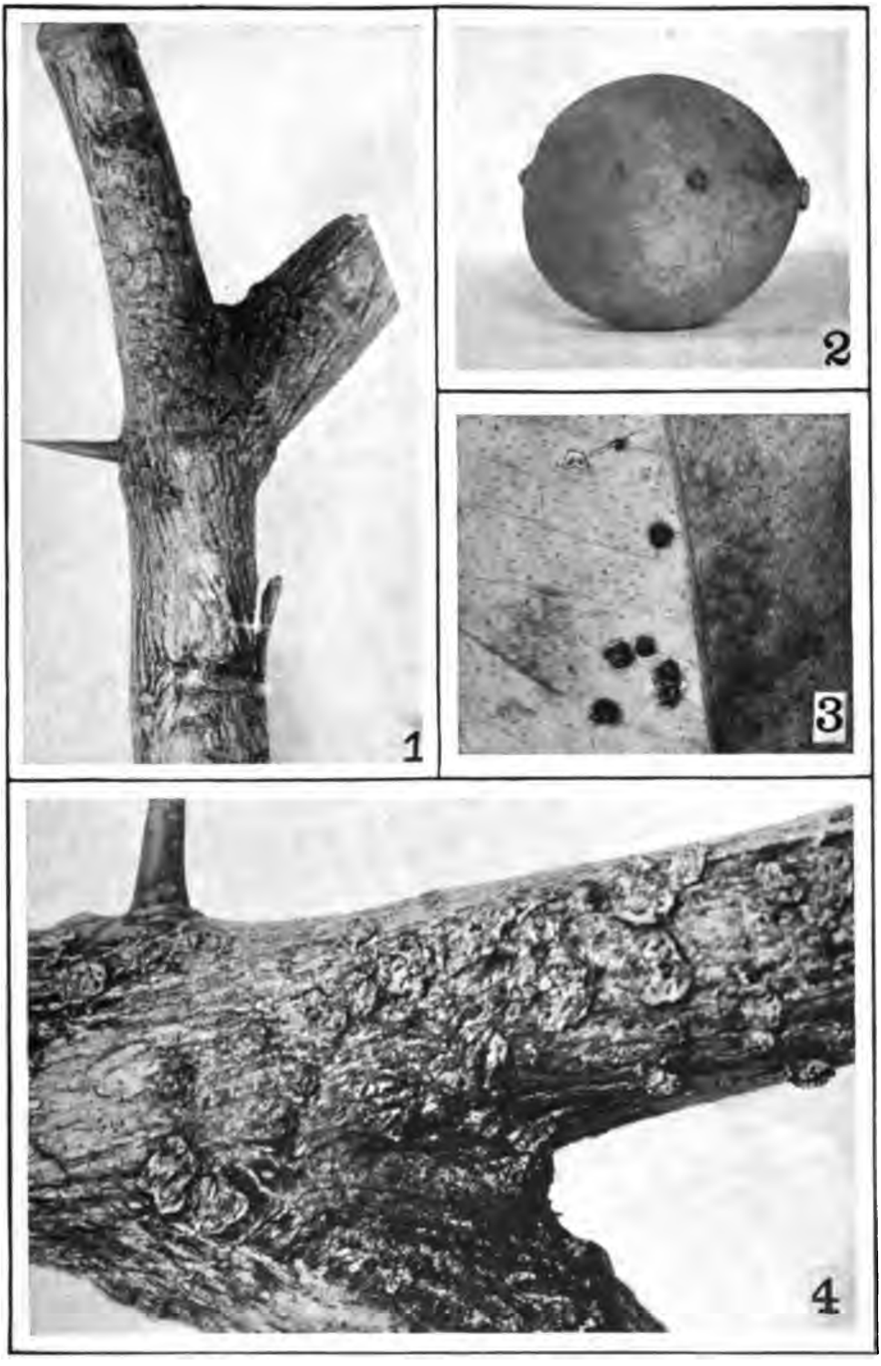
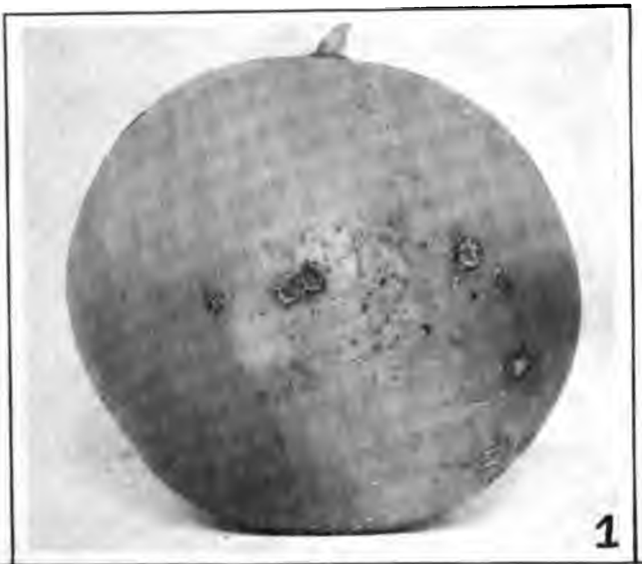
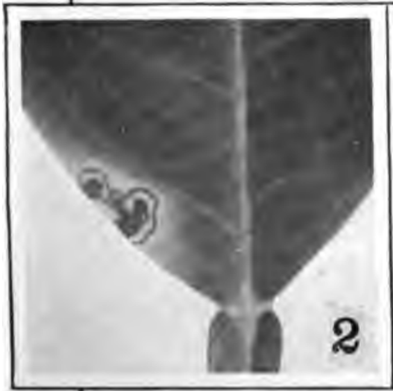
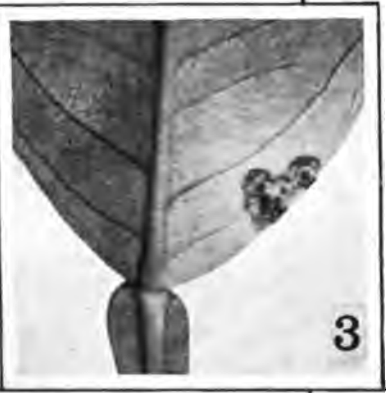


Figure 1. Canker on lime wood. Natural size. Collected in Brevard County. Figure 2. Canker on lime fruit. Natural size. Collected in Brevard County. Figure 3. Very young canker on lower surface of lime leaf. Enlarged three diameters. Collected in South Dade County. Figure 4. Portion of lime wood represented in Figure 1 enlarged three diameters. Note that the canker is rougher and more irregular than on young twigs.







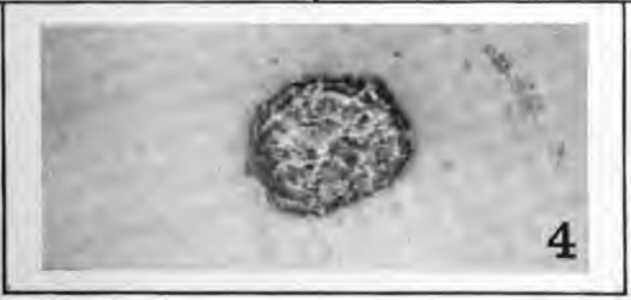


Figure 1. Canker on fruit of orange. Natural size. Collected in Brevard County. Figure 2. Canker on upper surface of orange leaf produced by inoculation with canker organisms (Pseudomonas citri Hasse). Enlarged three diameters. The spot is the result of the fusion of five infections. The spots were first observed thirty-five days after inoculation and photographed one month later. Figure 3. Lower surface. Figure 4. Canker spot on fruit represented in Figure 1 enlarged three diameters. Note the general roughness of the surface which is characteristic of canker on orange fruit.

PLATE XII

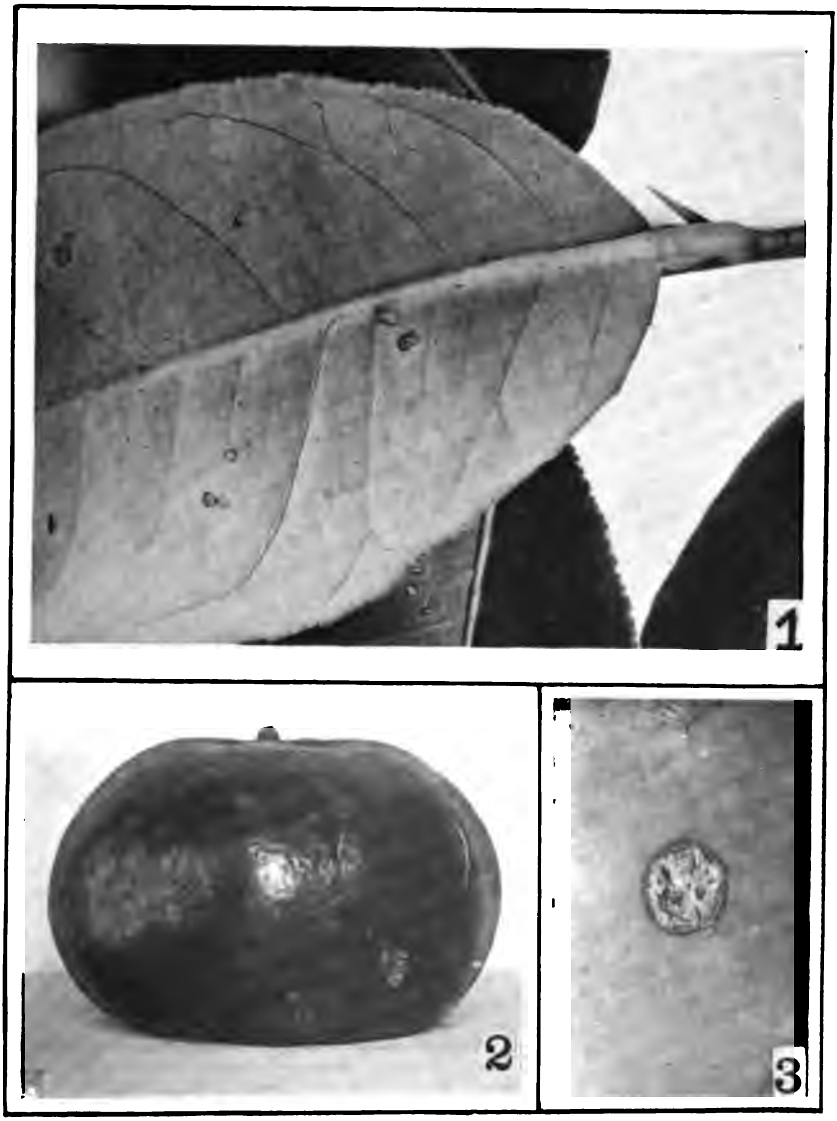


Figure 1. Canker on leaves and twig of ponderosa lemon produced by inoculation with canker organisms (Pseudomonas citri Hasse). Enlarged three diameters. Canker was first observed twenty-two days after inoculation and was photographed five days later. Figure 2. Canker on fruit of tangerine. Natural size. Collected in Brevard County. Figure 3. Canker on tangerine fruit enlarged three diameters. Note the deep cracks and fissures. These are characteristic of the disease on tangerine fruit. Collected in Brevard County.

Plate XIII.—The Tropical Laboratory. Erected at Redland, Dade County, by the South Dade County Fruit Growers' & Truckers' Association. The building contains a spacious auditorium used for Association meetings and a commodious laboratory room used by the State Plant Board for citrus canker investigations (Original).

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 JANUARY, 1917 No. 2

DIRECTIONS FOR BUILDING FUMIGATING BOXES AND FOR FUMIGATING WITH HYDROCYANIC-ACID GAS

E. W. BERGER

The following directions and illustrations represent a type of fumigating box long in use in Florida, and are largely based on directions found in Bulletins 67 and 76, Florida Experiment Station, by H. A. Gossard. It can be constructed of any kind of material; wood, concrete, brick, etc. The materials used for the box indicated in the directions are wood, galvanized iron, felt roofing, and concrete for the foundation. The galvanized iron top, or lid, soldered along the riveted joints, is recommended, because it is absolutely gas-tight and also rain-proof. The iron lid, or cover, is supported by three 2″x3″ strips of wood, lengthwise underneath, and three 2″x4″ strips, crosswise on top, all bolted together through the cover. The three strips of wood on top serve to hinge the cover to the three posts back of the box, and the middle strip also serves for attaching the rope. The body of the box is built of plain boards, placed horizontally, double walled, with a 4-inch space between the walls all around, which space is filled with dry sand to make it air-tight. The boards should be nailed every three feet to upright pieces, or studs, 2 by 4 inches, placed within the double walls. All the upright pieces within the double walls must be 2 inches shorter than the height of the box to allow space for the flange on the cover. The outside walls of the box are covered with a good quality of felt roofing to keep them dry.

A concrete foundation, 6 by 8 inches, or as much deeper as necessary, is recommended, as it will keep the box off the ground and from rotting, especially if the covering of felt roofing on the sides is allowed to project ½ inch below the box proper and over the foundation. The space inside the foundation is filled with dry earth, and no other kind of floor is needed. Plants with roots likely to be injured by fumigation may be "heeled in" in the earthen floor and then fumigated.

If cheapness is a desideratum, or if the box can be built under cover of a building, the covering of felt roofing and the concrete foundation can be omitted, and the lid made of boards, lined with felt paper, with flange of tin or wood.

If desired, a small door about 1 foot square, for inserting the chemicals when fumigating, may be constructed at the middle and base of the front side. This must be made to fit tightly by means of felt and kept closed and in place by some suitable device. The writer has himself preferred to introduce the chemicals through the top, suspending the cyanid over the fumigating jar by a string passing through a piece of gas pipe

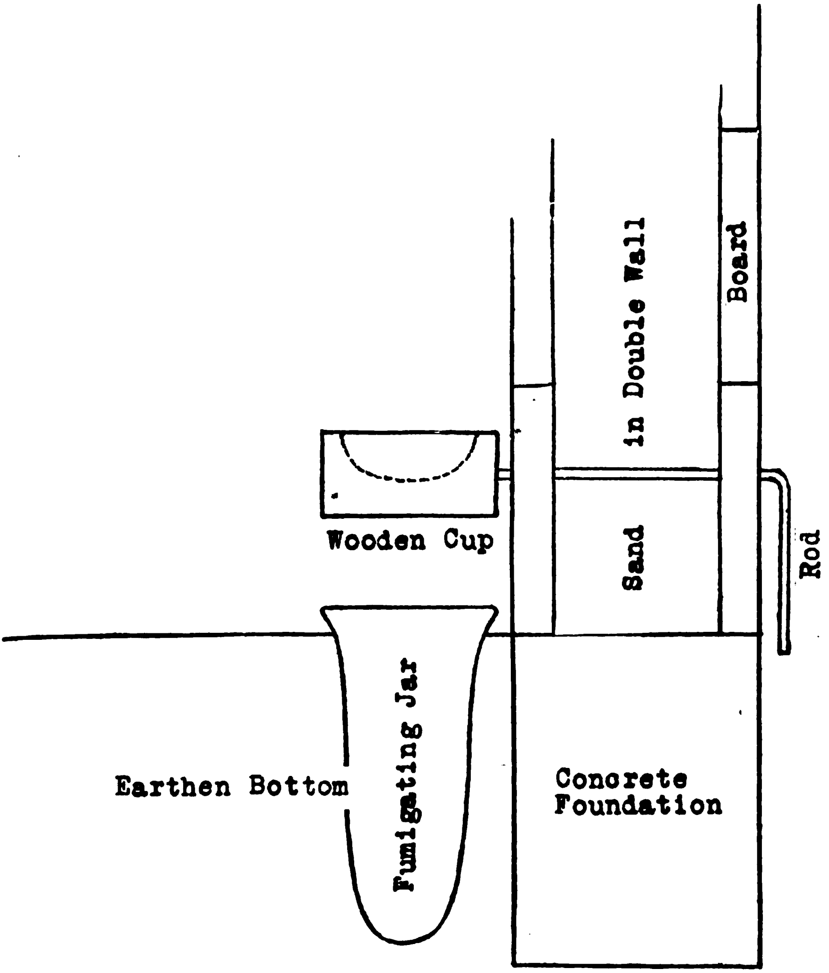


Fig. 1.—Cross section through front wall of fumigating box between xx (figs. 2 and 3), illustrating the rod-and-cup device for dropping the cyanid (About ¼ actual size).

near "x" (See Plates XIV and XV). After placing the trees and closing the box, the cyanid is released and the gas pipe closed with a stopper.

Another, less simple but more practical, device for dropping the cyanid into the fumigating jar containing the water and acid has been suggested by a correspondent. This consists of an iron rod, 3/16 or ¼ inch in diameter, inserted through the front wall between "xx" (See illustrations). The rod must project 2 or 3 inches on the inside of the box, far enough to extend over the fumigating jar, and on the outside far enough so that it can be bent once at a right angle to form a crank 3 to 6 inches long, but without a handle. When in position on the box, the crank of the rod should be turned down, and a wooden block, about 4 inches square and 2 inches thick, fastened to the inner end of the rod by inserting the latter into a suitable hole bored into one edge of the block. The upper surface of the block should be hollowed out sufficiently like a shallow cup to hold about an ounce of cyanid. This rod-and-cup device should be sufficiently below the rack (See next paragraph) for supporting the trees so that when the block, or cup, is inverted by turning the crank on the outside it will drop the cyanid into the vessel beneath it without touching the rack. With the rod-and-cup device, the cyanid need not be wrapped in paper.

Some form of simple rack, or false bottom, for keeping the trees to be fumigated off the earthen bottom, or floor, should be constructed. This can be done by nailing two cleats, about 6 inches from the bottom, on the sides for supporting suitable cross-pieces. The gas is generated beneath this rack so that it will readily spread throughout the space under the rack and then diffuse upward through the trees. A few short pieces of boards, together about a foot square, should be arranged each time, before placing the trees to be fumigated, immediately above the vessel in which the gas is generated, in order to spread the gas and to keep it from injuring the trees immediately above. If a string is provided to release the cyanid, this should pass through a crack between these boards.

A fumigating box recently constructed for the Plant Board and University of Florida, herewith illustrated, was built of these materials, and it is believed will last 25 years without repairs, except that the posts to which the lid is hinged and the tackle fastened, and the wood on top of the lid, may have to be replaced in time. After some years the galvanized iron top may require a coat of paint. This box cost, completed, about $40.00.

If the extent of the business requires larger fumigating accommodations, an air-tight house of necessary size may be built, having at least two chambers so that one can be emptied and refilled while the other is being fumigated. The fumigating chambers in such a house are perhaps best made air-tight by plastering them with an extra heavy coat of ordinary house plaster. The doors should be made of two thicknesses of matched flooring, well painted, and with tarred paper between. They can be made to fit air-tight by means of strips of felt against which the door is clamped by means of some convenient device. Large ventilators that can be opened from the outside should be constructed near the ceiling for ventilating the rooms after fumigating.

SUMMARY OF DIMENSIONS

The following specifications are for a box of 99 cu. ft. capacity, or practically 100 cu. ft., a very convenient size. Double walls of plain boards, covered on outside with felt roofing. Inside measurements, 3 ft. wide, 11 ft. long, 3 ft. high; outside measurements, 4 ft. wide, 12 ft. long, 3 ft. high. Uprights between walls, at corners and sides, to which the boards are nailed, 2 by 4 inches, by 2 ft. 10 in. high.

Galvanized iron cover, or lid, 4 ft. 8 in., by 12 ft. 8 in., allowing 4 inches extension at edges like a roof. Galvanized iron flange, as per illustration, projects 2 inches downward from under side of cover. Space inside flange is 3 ft. 6 in. by 11 ft. 6 in. Downward projecting part of flange is 7 inches from outer edge of cover. It is believed that, if ½ inch of the outer edge of lid were turned down like a small flange or beaded and stiffened with a heavy wire, the same would look better and keep the edge of the cover from warping.

Concrete foundation, 6 in. by 8 in. Space inside, 3 ft. by 11 ft.; outside measurements, 4 ft. by 12 ft.

Posts, 6 in. by 8 in., placed about 6 inches from back of box, may be used for hinging cover and attaching rope and pulley. In the illustration, four posts were used, but three are sufficient, the middle one being allowed to extend at least 6 ft. above top of the box. These posts should extend 3 to 4 feet into the ground.

SUPPLIES NEEDED

Cyanid, sulphuric acid and water are the materials employed. Potassium cyanid was, until a few years ago, used, but sodium cyanid has now come into general use. Sodium cyanid is cheaper and is an American product; besides, the potassium cyanid cannot be readily obtained at this time.

The cyanid used, if sodium cyanid, should be 96-98% pure; if potassium cyanid, it should be 95-96% pure. Sodium cyanid has sometimes been designated as 129% cyanid, since an equal amount by weight of sodium cyanid liberates 29% more gas than does potassium cyanid. It is now designated as 96-98% cyanid.

It must never be forgotten that cyanid is a DEADLY POISON and that a very small amount if introduced into the mouth will cause death. It is best to use forceps in handling it, and never allow it to touch cuts or open sores on the hands. It should be kept away from children and uninformed persons. The gas generated from it is very deadly and while no fatalities have ever attended its use as an insecticide, such have occurred in chemical laboratories, and the greatest caution should be observed in working with it. It should be kept in tightly stoppered glass bottles or tightly closed fruit jars, since it will deteriorate rapidly and absorb moisture if exposed to the air.

Cyanid can be obtained in one ounce egg-shaped pieces or in the granular form. Unfortunately, an ounce piece is too large for the 100 (99) cu. ft. box recommended, and only a few persons will probably have use for a larger box. Those desiring to do so may build a box of 200 cu. ft. capacity, when a one-ounce piece will just be sufficient to fumigate citrus trees. To avoid the inconvenience of breaking the one ounce pieces, the majority no doubt will prefer to use the granular kind.

The following prices on granular sodium cyanid were received on June 28, 1916, f. o. b., New York:

1 tin 50 pounds at	29½c per lb.
1 tin 25 pounds at	31 c per lb.
1 tin 10 pounds at	31½c per lb.
1 tin 5 pounds at	32 c per lb.
1 tin 1 pound at	35 c per lb.

Cyanid can be obtained from druggists, wholesale druggists, and manufacturers of chemicals.

Commercial sulphuric acid, 66 degrees Baume, which is approximately 93% pure, must be employed. This can gen-

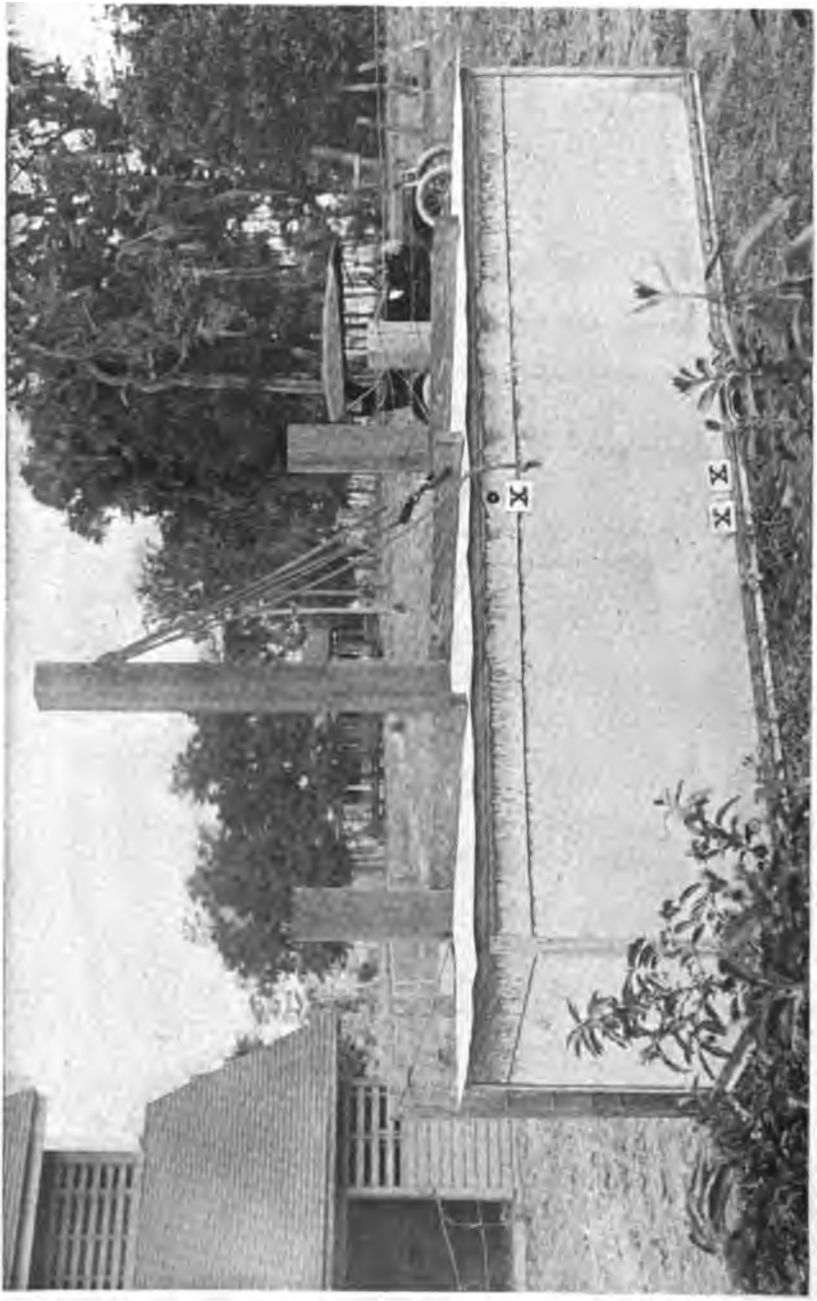


Plate XIV.—Fumigating box (Original).

erally be obtained from druggists, wholesale druggists, or fertilizer manufacturers.

Vessels of earthenware, china or glass must be used for generating the gas, since the acid employed will rapidly destroy metal and wood. An ordinary pint fruit jar will do for ½ oz. to 1 oz. of cyanid, but a narrower vessel with a bowl-shaped bottom is better, in order that the liquid (acid and water) will be deeper and better cover the cyanid when put in. A deep pint glass tumbler, a deep earthenware bowl, or a large coffee cup would also be excellent. A vessel holding only ½ pint is rather small for the amount of cyanid and chemicals necessary to charge a 100 cu. ft. box like previously described, since the liquid may boil over.

For measuring liquids, a glass graduate, or measuring glass, having a capacity of three or four liquid ounces, graduated in fourths or eighths of an ounce, is required. A glass graduate, graduated in the metric system, may be used, and 30 cubic centimeters allowed for an ounce. Druggists should be able to supply these graduates. Suitable scales for weighing ounces and fractions of an ounce are necessary.

FORMULAS

SODIUM CYANID.—To fumigate citrus trees, immature peach trees, roses, buds and scions in a fumigating box, with sodium cyanid, ½ oz. per 100 cu. ft. space is required. The necessary amounts (liquid measure) of acid and water are respectively 1½ and 3 times the amount of sodium cyanid as expressed in avoirdupois ounces.

To fumigate dormant peach trees, or similar hardy deciduous trees like apple, pear and plum, with sodium cyanid, ¾ oz. per 100 cu. ft. box space is required.

The formulas for fumigating with sodium cyanid may be tabulated as follows:

Citrus, etc.:
½ oz. sodium cyanid, 96-98% pure.
¾ oz. sulphuric acid, 66 deg. Baume, or 93% pure.
1½ oz. water.
Time 30 minutes.

Peach, etc.:
¾ oz. sodium cyanid, 96-98% pure.
1⅛ oz. sulphuric acid, 66 deg. Baume, 93% pure.
2¼ oz. water.
Time 30 minutes.

POTASSIUM CYANID.—The formulas for potassium cyanid are included for the benefit of those who may still have this cyanid on hand.

Citrus, etc.:
- 3/5 oz.* potassium cyanid, 95-96% pure.
- 3/5 oz. sulphuric acid.
- 1-4/5 oz. water.
- Time 30 minutes.

Peach, etc.:
- 1 oz. potassium cyanid.
- 1 oz. sulphuric acid.
- 3 oz. water.
- Time 30 minutes.

CHARGING THE BOX

Place the vessel for generating the gas, containing the necessary amount of water, in position on the earthen floor, inside the box near the middle of the front wall. This vessel may be partly buried in the earth of the floor to support it in position. After the water, add the required amount of acid. Adding the acid will heat the mixture. (*Always* pour the acid into the water, *never* the water into the acid, in order to avoid splattering of the liquids). Next suspend the required amount of cyanid, wrapped in a bit of tissue paper, in the mouth of the generating vessel (but not touching the liquid for the poisonous gas is immediately generated) by means of a string passing through the front wall at x (See illustration); or place it in the cup of the rod-and-cup device described on page 16.

After placing the chemicals in readiness, place the trees to be fumigated into the box and close down the lid. See to it that the space between the walls is full of sand so that the flange on the lid will make a tight joint. Release the string, allowing the cyanid to drop into the mixture of acid and water, stopper the opening for the string and wait 30 minutes; or if the rod-and-cup device is used, simply turn the crank. Fumi-

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*Since 2/3 or 3/4 ounce may be more conveniently weighed on most scales than 3/5 ounce, these quantities may be employed; but as the dosage is thereby slightly increased, it is advised that experimental trials of these dosages be made before regularly employing them. The proportions of potassium cyanid, acid and water are 1: 1: 3, respectively, i. e., the number of ounces of acid (liquid measure) is the same as the number of ounces of potassium cyanid (ounces avoirdupois), and the number of ounces of water (liquid measure) is three times the number of ounces of potassium cyanid (ounces avoirdupois).

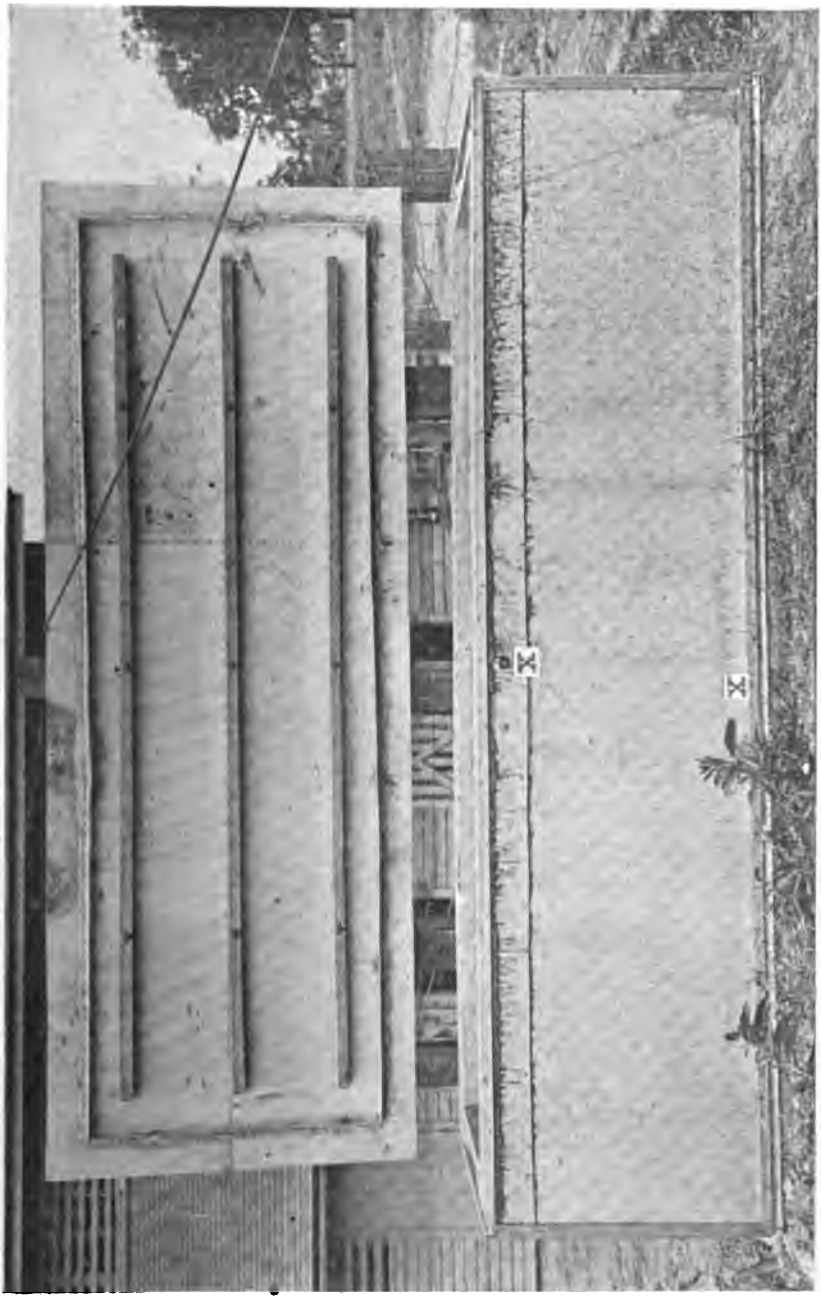

Plate XV.—Same box as Plate XIV, but with cover raised (Original).

gate while the mixture of acid and water in the generating vessel is still warm.

If the box has a small door on the side for introducing the chemicals, the trees should be placed in the box first and the lid closed down. The chemicals are then introduced through the small door: the water first, then the acid, and lastly the cyanid wrapped in a bit of tissue paper. As soon as the cyanid has been dropped into the generating jar, or vessel, rapidly close the door and fasten it into position.

After 30 minutes open the lid and allow the box and contents to air for some minutes, before removing the trees. The residue in the generating vessel should be buried as it is corrosive and poisonous.

MISCELLANEOUS SUGGESTIONS

Trees and plants to be fumigated should have no visible moisture upon them; neither should they be packed so closely that the gas cannot circulate between them.

All citrus and deciduous trees should be defoliated as required by law before fumigation, as the leaves are quite certain to be injured by the gas and will interfere with the fumigation. Ornamental citrus in tubs or pots, and ornamentals in general, not intended for sale or exchange, may be fumigated without defoliation by employing a smaller dosage, which dosage may have to be determined by trial.

Those desiring more detailed information on the fumigation of many plants are referred to "Fumigation Methods," by W. G. Johnson, the Orange Judd Company, New York.

CHARACTERISTICS OF CITRUS CANKER AND OF THE CAUSAL ORGANISM

R. A. JEHLE

A previous article* by the writer was devoted to descriptions of citrus canker and to the means of identifying it. The present paper aims to give such additional information as will enable citrus growers to attain an adequate knowledge of the disease, its nature and the respects in which it differs radically from other diseases.

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*The Quarterly Bulletin, Vol. I, No. 1, pp. 2-12 (1916).

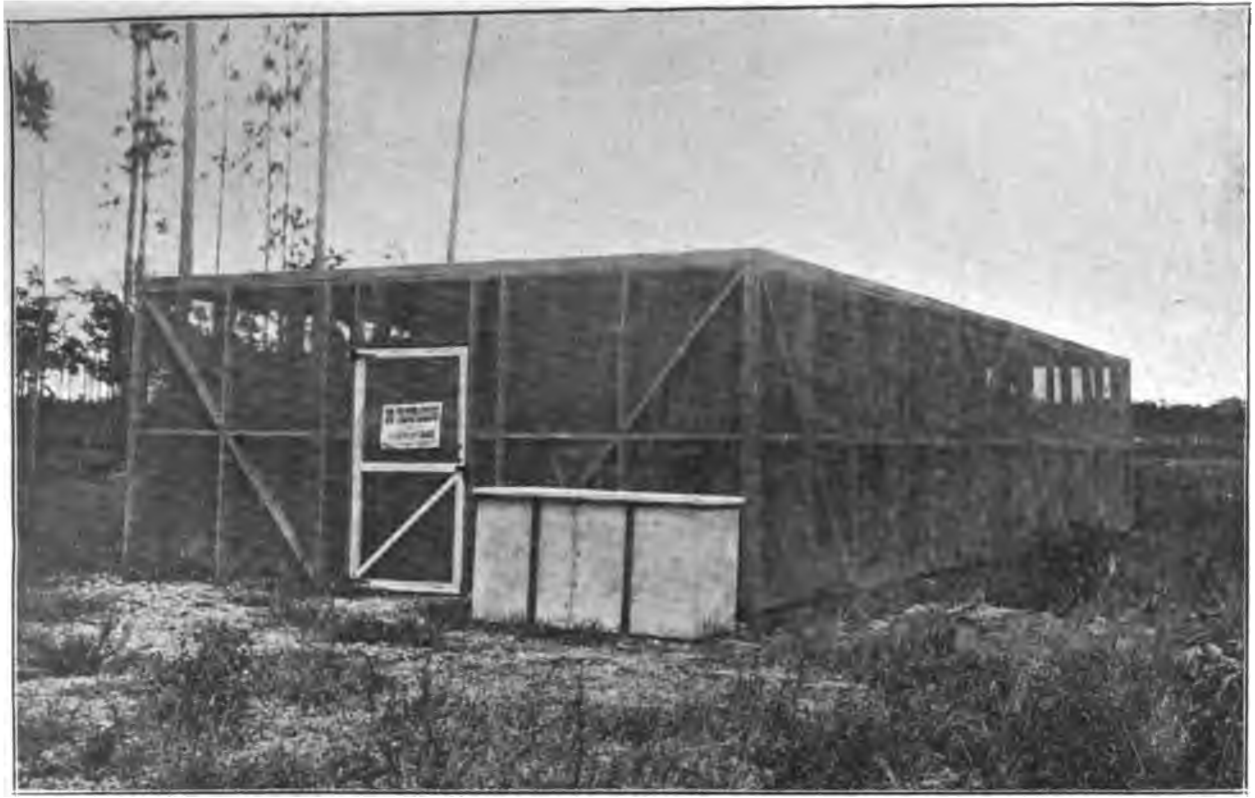

Plate XVI.—Screened cage, with compartments, used for experiments with citrus canker. In the foreground is a galvanized box used for fumigation experiments (Original).

FIELD INVESTIGATIONS

The writer commenced his investigations of citrus canker in Dade County in August of 1915. The disease was carefully studied in the field but the opportunity for such observation was considerably limited as the infected trees are destroyed as soon as possible after being discovered.

One of the first characteristics noted was that, where several infections occurred on a single tree the younger ones were usually located below the older ones, frequently very near to them. Sometimes one mature infection was observed with numerous immature infections below radiating from it. Infections were often observed along the edges of bites made by insects (Plate XX, 1), and on other parts of the leaf adjacent to them.

Sometimes most of the trees which were found to be infected in a grove were located along paths frequented by men and domestic animals. In other groves, frequented by domestic fowls, most of the infections were located near the ground. There are cases on record where infections have been found in the tops of trees, apparently on account of dissemination by insects or birds. These observations lead to the conclusion that the disease is distributed by mechanical carriers. Rain and dew play an important part in carrying it from place to place upon the same tree or to adjoining trees during storms or when the branches interlock. Insects are probably responsible for much of the distribution to different parts of the same tree as well as to different trees. Men and domestic animals are the greatest disseminators. Birds may at times be responsible for distribution but where the inspection work is close and frequent, infections are invariably detected in early stages and destroyed before birds have any appreciable opportunity to come in contact with the infected portions.

In connection with the field work the varying appearance of canker was noted at the different seasons of the year, as well as its peculiarities upon different citrus host plants.

LABORATORY WORK

The necessity for studying citrus canker upon its host plants was self-evident. Such work could not be conducted in the groves because of the danger of the disease being further disseminated. Experiments under grove conditions with a disease of such virulence would have been foolhardy in the extreme. One of the first undertakings, in connection with the Tropical Laboratory at Redland, was the construction of a screened cage (Plate XVI) in which inoculated and infected plants could be kept under observation. The framework was made of substantial timbers, securely braced and well anchored as a precaution against its being destroyed by tropical storms. Sides and top were doubly screened, on the outside with galvanized netting and on the inside with bronze screen of fine mesh. This screening, coupled with a moat about the base, rendered the cage practically insect-proof. Within, the cage was divided into two divisions, separated by an aisle (Plate XVII). Each division was divided into compartments or rooms, each room being separated from other rooms and the aisle by screened partitions. The cage is kept securely locked at all times and no one is permitted to enter the cage or any portion of it except under suitable sanitary precautions. Later on, another screened cage was constructed in which to keep a stock of young citrus trees prior to their inoculation. In connection with the experiments carried on in the screened cage, records of humidity and temperature are kept by means of a hygrothermograph installed in a standard instrument shelter near at hand.

Within the laboratory the usual equipment for bacteriological and pathological work was installed. As soon as facilities and materials were available media were prepared upon which to grow the canker bacteria. Both liquid and soluble media were used, the media being solidified by the addition of a jelly-like substance known as agar.

The citrus canker organism, *Bacterium citri,* was isolated from infected leaves, fruit and twigs collected in various groves. Owing to the nature of the disease the infected portions of the citrus plant are frequently invaded by saprophytic organisms. Many of these grow on artificial media in a manner very similar to the canker bacteria and can be distinguished from the latter, either by their manner of growth on media or under the microscope, only with difficulty. In order to determine positively which of the cultures secured from infected tissue were *Bacterium citri* it was necessary to inoculate citrus trees with all which resembled the canker organism. Potted grapefruit trees, with which every precaution had been taken to prevent danger of previous infection, were used for this purpose on account of their susceptibility. A separate tree was used for

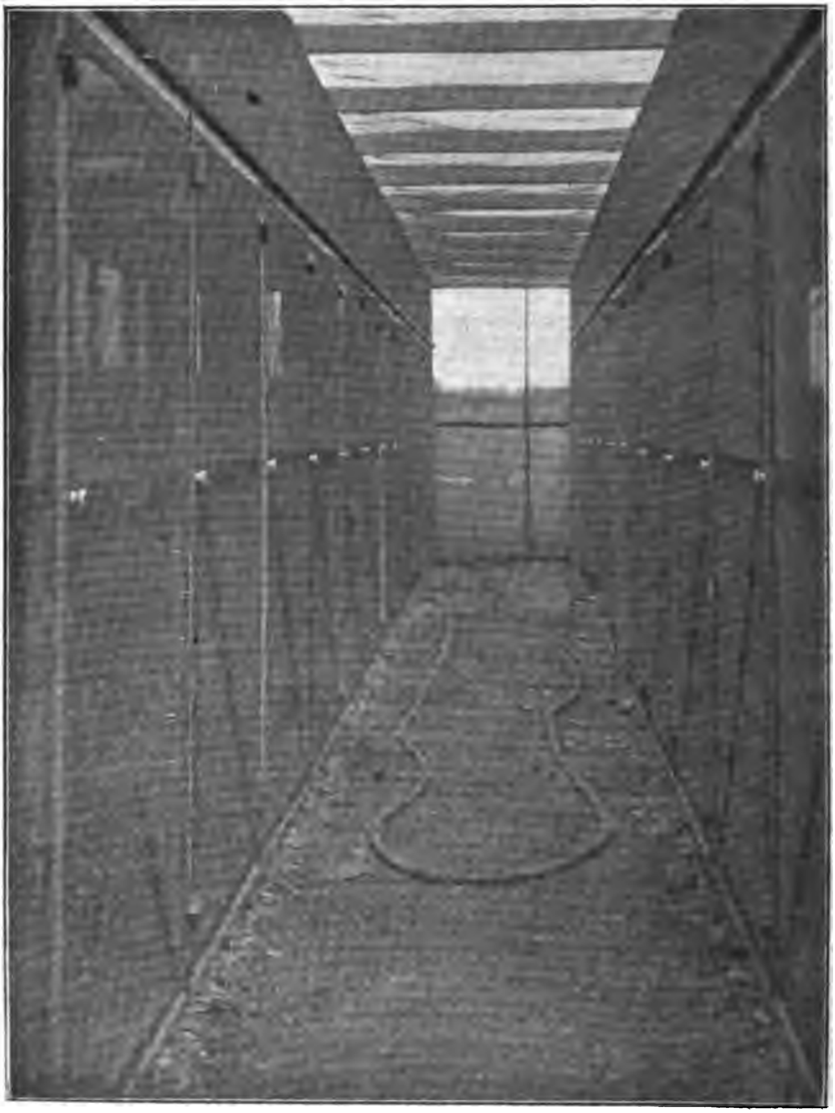

Plate XVII.—Interior of the screened cage, showing central aisle and doors to screened rooms on each side (Original).

each culture. The trees were inoculated by spraying them with a small atomizer containing a suspension of the culture in sterile distilled water*. After inoculation the entire tree was covered with a lamp chimney plugged with cotton at the upper end (Plate XXI, 1). In some instances canvas frames were used to prevent the trees from drying off and during hot summer weather both lamp chimneys and frames were used. These were employed to prevent the trees from drying, as the disease develops most rapidly when the humidity is high. The coverings were allowed to remain over the trees for several days in order to give the organisms time to gain entrance into the tissues of the inoculated plants.

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*Distilled water for use at the laboratory has been generously donated by the Ice, Light and Power Co. of Florida City.

No visible evidences of infection were observed in the first tests until thirty to forty days after inoculation, probably due to the cool weather prevailing at that time. Subsequent inoculations gave quicker results. Inoculated trees are kept in the screened cage and frequently inspected and upon infections appearing which can be positively identified as citrus canker they are removed to other compartments used exclusively for infected trees.

Tests have been made in the laboratory of the effect of various disinfectants upon the canker organism. Liquid disinfectants were tested by transferring canker organisms from pure cultures into one cubic centimeter of the disinfecting solution, then after a recorded time, introducing a loop of this solution, containing the organisms in suspension, into a sterile Petri dish and pouring on the agar. In some cases the liquids were poured directly on the organisms in the cultures instead of introducing them into the one cubic centimeter of solution. Cultures of different ages and from different sources were used and the pathogenicity of the cultures frequently tested by inoculation of grapefruit seedlings. All experiments were checked by the use of untreated cultures.

Gases were tested by exposing Petri dishes containing the organism to the gas in a fumigating box (shown in the foreground, Plate XVI). In some cases the organisms were sprayed onto the surface of the glass and allowed to dry. The plates containing the dry organisms were then fumigated and the agar poured into them. If the organisms were killed by the gas used for fumigating no growth occurred on the agar, but when they were not killed colonies would grow out in the agar within a few days. In other cases the agar was poured into the plates and allowed to harden, then the organisms were sprayed on the surface and the plates were fumigated. In all cases the plates were kept for at least one week after fumigation and observed for signs of growth.

Reference to the results of various experiments is made from time to time in subsequent paragraphs of the present

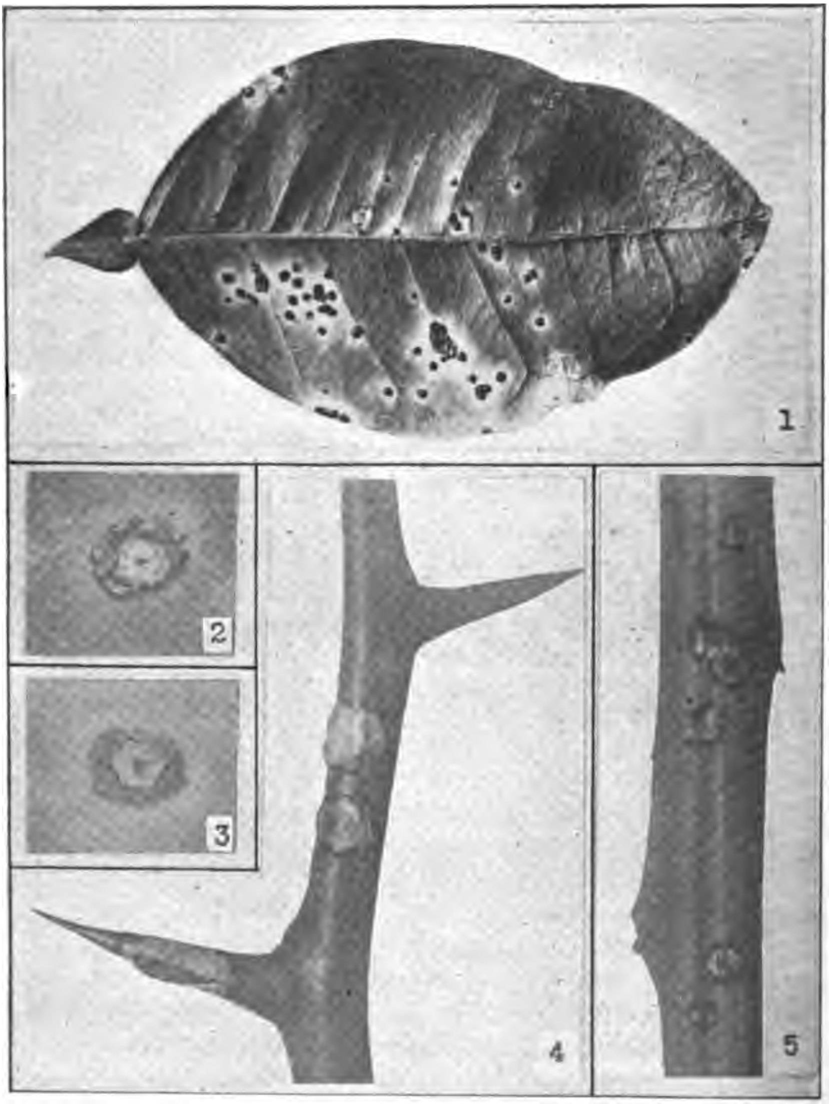

Plate XVIII.—Citrus canker: (1) lower surface of grapefruit leaf infected with canker showing the circular raised spots surrounded by yellow halos; (2) mature canker infection on upper surface of grapefruit leaf, showing crater-like appearance; (3) lower surface of leaf shown in (2); (4) infection on twig and thorn of Citrus trifoliata, showing longitudinal splitting of the membrane; (5) infections on grapefruit twig. No. 1, natural size; Nos. 2, 3, 4 and 5 enlarged three diameters (Original).

paper and the results of experiments now under way but incomplete will be presented in future reports.

HOSTS

Citrus canker has been found on almost all kinds of citrus plants, and it is likely that none of them is immune, although they vary in their susceptibility. The artificially infected plants in the screened cage at the laboratory varied in susceptibility in the following order: Pomelo (grapefruit), ponderosa lemon, key lime, Citrus trifoliata, sour orange, tangelo, sweet orange, tangerine, king orange, mandarin-lime, and kumquat. The grapefruit, ponderosa lemon, Citrus trifoliata, sour orange and tangelo varied but little in susceptibility. The mandarin-lime and kumquat seemed to be very resistant as but few infections developed on them and these developed very slowly. The disease has also been reported on the naval orange, mandarin, satsuma, common lemon, and rough lemon. It has not been reported on any non-citrus plants. Berger* observed that citrus plants varied in susceptibility in the following order: Pomelo (grapefruit), Citrus trifoliata, key lime, naval orange, sweet orange, Satsuma, tangerine, mandarin, king orange and lemon.

INFECTIONS ON MATURE FRUIT

Ripe grapefruit, oranges, tangerines, satsumas and kumquats were inoculated in the laboratory by spraying them with an atomizer containing a suspension of the canker organisms in distilled water and then keeping the inoculated fruits in a saturated atmosphere. These fruits never developed canker lesions, although grapefruit seedlings inoculated with organisms from the same cultures showed infections. It appears very improbable that the canker lesions will develop upon ripe citrus fruit after it is picked from the trees, but such fruit can, nevertheless, serve as mechanical carriers for the organisms just as other articles, such as clothing, tools, etc., do. Mature fruits with numerous canker lesions on them have frequently been encountered on infected trees but the lesions in such cases apparently developed while the fruit was still immature or at least in the process of growth and maturity.

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*Berger, E. W.—Citrus Canker in the Gulf Coast Country, with Notes on the Extent of Citrus Culture in the Localities Visited. Fla. State Hort. Soc. Proc., 1914, p. 122.

DISTRIBUTION

The disease was probably introduced into the Gulf States on nursery stock from Japan. According to Berger, Stevens and Stirling* and Edgerton and Garrett** the first shipments of infected citrus nursery stock were planted at Alvin and Port Arthur in Texas, at Lafayette in Louisiana, at Wiggins in Mississippi and at Monticello in Florida. Canker also occurs in Alabama. According to Fawcett† it is not known to occur in California. In a paper read before the Citrus Seminar at Gainesville on October 6, 1915, Dr. W. T. Swingle reported finding the disease in Japan, the Philippine Islands and China. After making a thorough study of the disease in parts of these countries which he visited he concluded that it had been introduced into all of them, namely, that it was not endemic. Specimens of citrus canker have been received by Stevens from Australia, Java and Singapore, indicating that it occurs in those countries. The disease is also now known to be present in certain parts of South Africa.

ECONOMIC IMPORTANCE

The citrus canker disease is undoubtedly the most serious disease of citrus plants which has yet come to the attention of either growers or authorities. Swingle stated that in Japan it causes almost a total loss of the Washington Navel crop during warm moist seasons. According to Stevens‡ it is one of the worst plant diseases that has appeared in Florida, and Wolf§ states that it is the most destructive malady affecting species of citrus.

While there is a marked tendency on the part of the public generally to regard canker in much the same light as one thinks of whitefly, purple scale, die-back or other insects or diseases affecting citrus, those who have had first-hand experience with the disease are convinced that it is far more destructive than any trouble with which the citrus growers generally are familiar. For those who have seen the destruction wrought by citrus canker in its advanced stages the conviction has been unavoidable that the disease will, if not eradicated, completely ruin the grapefruit, lime and round orange industries of Florida and seriously interfere with the successful production of other citrus fruits. On trees where the infection is of a few months' standing all fruits are infected and all infected fruits are culls of the poorest sort, entirely unmarketable (Plate XX, 3). A tree which cannot produce marketable fruit is of course worthless and even if the disease did not destroy the tree itself the loss to the grower would be complete. Aside from ruin of the fruit, however, infected leaves drop prematurely, weakening the tree and even killing it in time. Infections on the twigs frequently girdle the latter causing the death of all parts beyond the infection. Even when the twigs are not completely girdled the trees are injured by the resulting interference with the passage of food and water. Artificially inoculated trees in the screened cage have all been more or less injured by the disease and many have lost their leaves. Two of the grapefruit seedlings have been killed and others have been so seriously injured by the disease that they cannot survive (Plate XXI, 3).

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*Berger, E. W., Stevens, H. E., and Stirling, Frank.—Citrus Canker II. Fla. Agr. Exp. Sta. Bul. 124, p. 28 (1914).

**Edgerton, C. W., and Garrett, J. B.—Citrus Canker. La. Agr. Exp. Sta. Circ. 15, p. 3 (1916).

†Fawcett, H. S.—Citrus Diseases of Florida and Cuba Compared With Those of California. Cal. Agr. Exp. Sta. Bul. 262, p. 169 (1915).

‡Stevens, H. E.—Citrus Canker III. Fla. Agr. Exp. Sta. Bul. 128, p. 3 (1915).

§Wolf, F. A.—Citrus Canker. Journ. Agr. Res., Vol. VI, No. 2, p. 69 (1916).

SYMPTOMS

The symptoms of citrus canker on various host plants and during different seasons of the year, together with a comparison with other citrus diseases, have been discussed and illustrated by the writer* and only a summary, together with observations made since the preparation of that article, will be given here.

The disease attacks the twigs, leaves, fruits, thorns and occasionally the larger limbs. The symptoms are very similar on all of these parts. Canker makes its first appearance as a small pimple-like watery dot, resembling a large oil gland (Plate XVIII, 1). On the leaves both the upper and lower surfaces become infected sooner or later and the disease has a very similar appearance on both surfaces. It may appear on either surface first or on both surfaces simultaneously. The pressure from within becomes so great that the outer membrane of the infected portion ruptures exposing a corky mass. The ruptured membrane sometimes persists but is usually sloughed off sooner or later. The corky tissue is at first slightly pink in color but soon it begins to darken and sometimes becomes almost black. Just outside of the central corky tissue where the disease is invading healthy tissue is a yellowish-brown, oily,

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*The Quarterly Bulletin, Vol. I, No. 1 (1916).

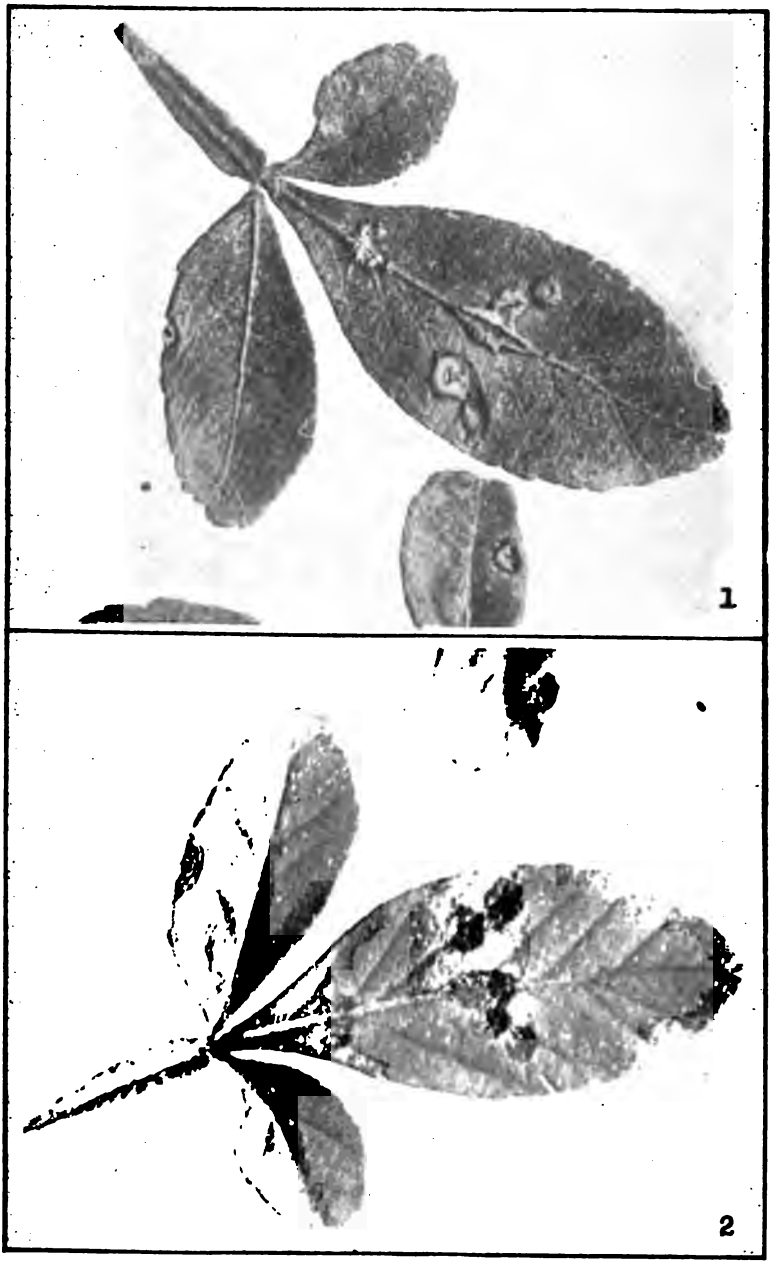

Plate XIX.—Canker infections on leaves of Citrus trifoliata produced by spraying with canker bacteria from pure cultures; 1, upper surface; 2, lower surface; all enlarged three times (Original).

glazed, translucent zone which varies somewhat in color and size under different conditions and upon different host plants. This zone may be surrounded by a yellow halo, but very frequently this halo is inconspicuous or wanting. The spots usually mature when they reach a diameter of one-fourth to one-half an inch. On the leaves a hollow is frequently formed in the center surrounded by a raised zone giving to the spot a crater-like appearance (Plate XVIII, 2 and 3). The central part of the diseased portion may drop out leaving a hole through the leaf. Typical canker spots are circular in outline, more or less elevated, and may occur singly or in groups. When in groups they often fuse forming larger more or less irregular areas. On the fruits canker may cause gumming in severe cases (Plate XX, 3). The disease does not penetrate very deeply into the rind but may pave the way for other organisms which rot the fruit. On the twigs it only penetrates to the wood. On the inoculated twigs, thorns, and leaves of Citrus trifoliata it developed in a very interesting manner. On the twigs and thorns it made its first appearance as a dark green watery blister which gradually increased in size until it caused a longitudinal splitting of the outer membrane. As it advanced the fissures made by this splitting became broader, and more splitting took place mostly in a longitudinal direction. The cankerous tissue consisting of yellowish-brown corky cells could be distinctly seen bulging up between the edges and cracks (Plate XVIII, 4). On the leaves the first evidences of infection were very similar to those on the twigs and thorns. The splitting of the outer membrane was more irregular than in the case of the twigs and thorns. No yellow halo was found at the edge of the canker infections (Plate XIX). The grayish membrane which covered the cankerous tissue seemed to persist longer in this host than in most other hosts.

ETIOLOGY

Citrus canker was at first thought to be of fungus origin and Stevens* and Wolf and Massey** succeeded in producing canker from what they thought were pure cultures of a fungus which they classified as a *Phoma* or *Phyllosticta.* Miss Hasse† demonstrated that it was caused by a bacterium which appeared to be a new species and which she called "*Pseudomonas citri.*" Stevens* had come to the same conclusion regarding its being

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*Berger, Stevens and Stirling, l. c., p. 39.

**Wolf, F. A., and Massey, A. B.—Ala. Agr. Exp. Sta. Circ. 27, pp. 99-100 (1914).

†Hasse, C. H.—Pseudomonas citri, the Cause of Citrus Canker. Journ. Agr. Res., Vol. IV, No. 1, pp. 97-100.

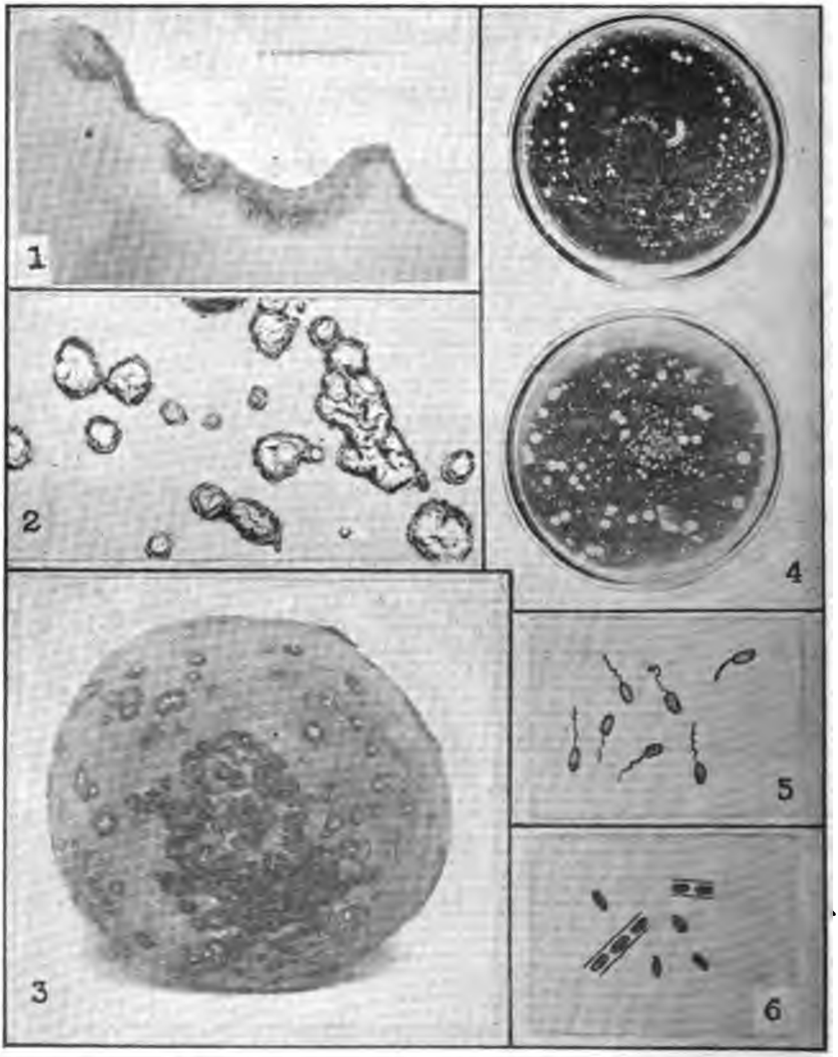

Plate XX.—Citrus canker: 1, lower edge of grapefruit leaf showing infection on edge of bite made by an insect; 2, infection on green grapefruit; 3, young grapefruit infected with canker with the gum oozing out in large masses; 4, Petri-dish cultures of Bacterium citri on nutrient agar; 5, canker bacteria showing flagellae (diagrammatic); 6, canker bacteria from one-day culture on nutrient agar, stained with carbol fuchsin. Nos. 1 and 2 enlarged three times; No. 3 natural size; No. 4 reduced one-third and Nos. 5 and 6 magnified 1,000 times (Original).

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*l. c., p. 12.

caused by a bacterium just before Miss Hasse's paper appeared. Wolf* and Stevens** accounted for their initial infections by the fact that their cultures were not pure and later confirmed the work of Miss Hasse.

The bacterium *Pseudomonas citri* Hasse, or *Bacterium citri* if Smith's classification is accepted***, described by Miss Hasse as the cause of citrus canker has been repeatedly isolated from leaves, twigs, and fruit of various citrus plants and has produced the disease in over 75% of the inoculated citrus trees. The organisms have been repeatedly isolated from these artificially produced cankers and the disease has been reproduced with the reisolated organisms. This leaves absolutely no doubt as to the cause of the disease. The artificially produced cankers do not differ from those found in the groves. Some variations were observed such as variations in the sponginess of the cankered tissue, in the presence or absence of a yellow halo, etc., but these differences were also observed in natural infections. No fungi were used in any of the inoculations and typical citrus canker developed without the presence of any fungi other than ordinary saprophytic moulds. Although fungi may assist in disintegrating the tissue killed by the canker organisms, they do not enter into the cause of the disease.

DESCRIPTION AND CULTURAL CHARACTERISTICS OF THE ORGANISM

Bacterium citri is typically a rod-shaped, uniflagelate organism rounded at both ends (Plate XX, 5). The flagellum is a whip-like appendage attached to the polar end. The bacterium measures 1.5 to 2 by .5 to .75 microns (15,000 to 20,000 placed end to end would measure about one inch) and may occur singly or in chains of several units. The bacterium is embedded in a jelly-like substance which probably gives it its viscidity. It stains readily with carbol fuchsin and methylene blue (Plate XX, 6).

When plated out on beef agar in the culture room (about 80°F) the colonies become visible at the end of 24 hours. They make their first appearance as small glistening dots and increase in size quite rapidly becoming conspicuous in a few days. They are circular in outline with an entire margin and a glistening slightly raised surface (Plate XX, 4). The interior of the colony has a fine granular structure. The color is light yellow by reflected light and bluish by transmitted

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*l. c., p. 74.
**l. c., pp. 12-13.
***Smith, E. F.—Bacteria in Relation to Plant Diseases I, p. 166 (1905).

light. On agar slants, growth becomes visible in 24 hours in the culture room. The growth follows the slant, is slightly raised with a moist glistening surface and has a dull yellow color. The outline of the colony is wavy (Plate XXI, 2). In beef bouillon there is a slight clouding after 24 hours. This increases as the culture becomes older and finally a yellow ring is formed at the surface. On potato plugs a slightly raised bright yellow growth is formed with a narrow white margin on the portion of the potato just outside of the colony. As the colonies become older this zone becomes less prominent and the growth becomes more vigorous and finally covers the entire plug. Other cultural characteristics are discussed by Hasse* and Wolf**.

PATHOGENICITY

Citrus canker was first considered to be infectious by Stevens† and Stirling‡ infected a grapefruit seedling by drawing an infected leaf, previously soaked in water, between the thumb and forefinger and then drawing a leaf of the seedling between the same fingers. Canker infections resulted in eight days. The pathogenicity of *Bacterium citri* was first observed by Miss Hasse, then by Stevens and later by Wolf. It has been repeatedly tested by the writer. Inoculations were made by introducing the organism into pricks made with a sterile needle and by spraying the trees with a suspension of the bacteria in sterile distilled water and keeping a film of water on the inoculated parts for at least 24 hours. The trees are just as easily infected by either method, but the former is preferable for testing the pathogenicity of different cultures. Conspicuous infections can be readily obtained in three to ten days by introducing many of the organisms directly from agar cultures into the pricks made with a sterile needle (Plate XXII). Check trees were sprayed with sterile distilled water or punctured with a sterile needle without introducing the organism. No canker infections ever developed in any of the checks.

Infections became visible in from three to ten days when the inoculations were made during the summer, and when they were made during the winter infections did not become visible until thirty to forty days after inoculation. In one instance the incubation period was 108 days and in another it was 136 days but cases of this kind were uncommon. There are cases on record where the disease has broken out one year or longer

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*l. c.

**l. c.

†Stevens, H. E.—Citrus Canker. Fla. Agr. Exp. Sta. Bul. 122, p. 117 (1914).

‡Tenny, L. S.—The Citrus Canker Situation in Florida. Fla. Growers' & Shippers' League Bul. 1, p. 15 (1914).

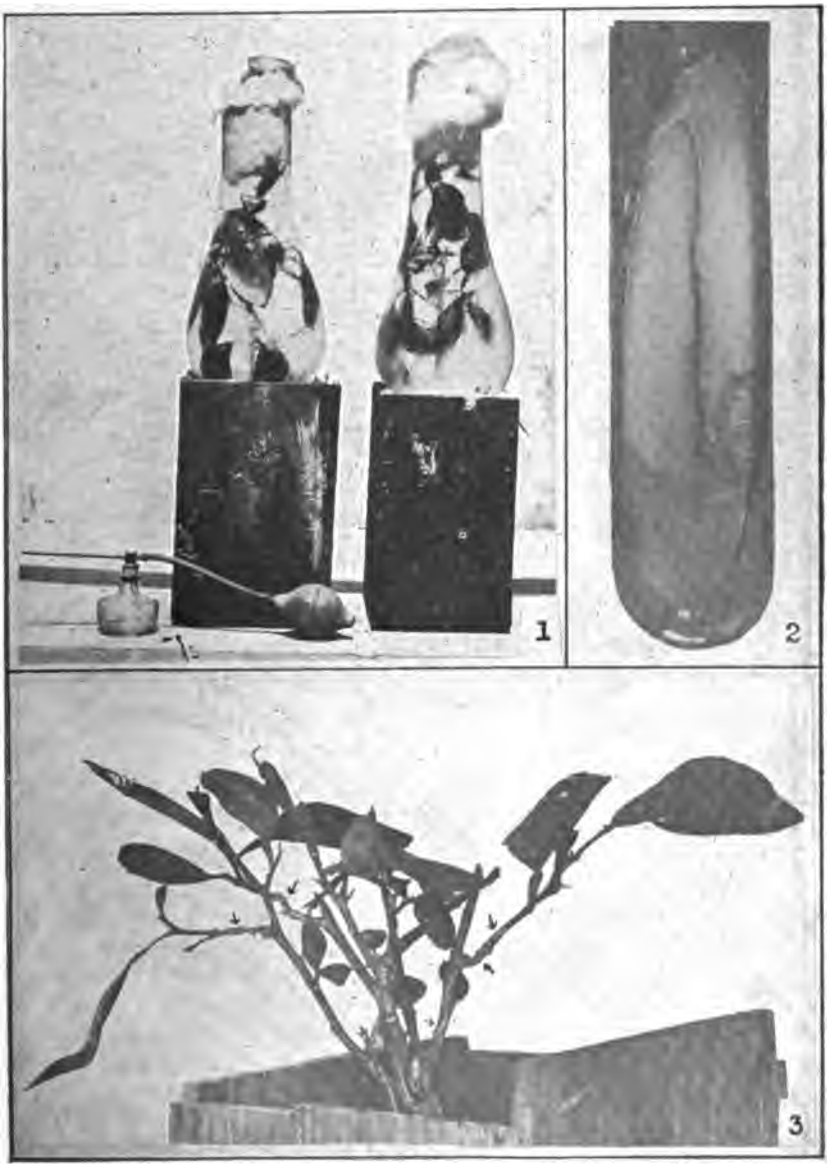

Plate XXI.—Citrus canker: 1, grapefruit seedlings enclosed in lamp chimneys after being inoculated by spraying with canker bacteria suspended in distilled water; 2, a pure culture of Bacterium citri on nutrient agar; 3, infected grapefruit seedling with twigs girdled by the disease (Original).

after the last infection was burned and the opportunities for infection from outside were few. In most of these cases the infections appeared soon after a new growth was put out. It is thus apparent that the condition of the trees has an influence on the period of incubation.

PATHOGENESIS

As stated above, field observations indicate that the disease is disseminated by mechanical carriers such as rain, dew, and animal carriers including birds and men. Farm machinery and tools, or anything else which comes in contact with infected trees, may carry the disease. When the canker spots are thoroughly wet the canker bacteria ooze out in great numbers and the droplets of water on the surface of the diseased parts may be teeming with them. This may be easily demonstrated by taking drops of water from infected parts after a rain and staining with carbol fuchsin. Such mounts will be seen to contain many canker bacteria when examined under the microscope. The bacteria are embedded in a sticky jelly-like substance and readily adhere to anything which may come in contact with them, thus being easily transferred from one place to another. When these droplets of water dry down in the gelatinous substance which surrounds them the bacteria are not easily detached. Thus the danger of disseminating the disease is much greater when the plants are wet than when they are dry. The organism has been transferred long distances mainly within the tissues of the host while the disease was invisible to the naked eye or so inconspicuous as to be easily overlooked. In this way it is frequently carried in nursery stock and budwood.

LIFE HISTORY OF THE PATHOGEN

The bacteria which cause citrus canker live within the tissues of the host and produce substances which cause the latter to disintegrate. When the infected portions are wet with dew or rain the bacteria ooze out in large numbers in a gelatinous mass with which they are invested. In this condition they are easily transported to healthy tissue where they may cause infection. Stevens, in announcing the results of his investigations, at the Citrus Seminar at Gainesville in October, 1916, reported that he had found the canker bacteria alive and virile in soil taken from the site of an infected tree destroyed nine months previously and that canker bacteria had survived for a period of seventeen months in otherwise sterile soil in his laboratory, producing typical canker infections on inoculated grapefruit seedlings at the end of this period.

Mention of an experiment by the writer with infected glade and red soil was made in a previous article[*].

EFFECT OF VARIOUS AGENCIES UPON THE CANKER ORGANISM

Stevens[†] found that canker organisms are killed by a 5 minute exposure to temperatures ranging from 55 to 60 degrees C. (132 to 140 degrees Fahrenheit), and according to Wolf[**] the thermal death point is between 58 and 70 degrees Centigrade.

Tests of the effect of various gases and solutions upon the canker organism are being made at the laboratory. The following substances were and are being tested: Formaldehyde gas, formaldehyde solution, hydrocyanic-acid gas, bichloride solutions in water and in dilute denatured alcohol, solutions of borax in water and of borax and glycerine in water, carbolic acid, copper sulphate, potassium permanganate, and coal-tar products. These tests are being repeated with cultures of various ages, upon various media, and with canker bacteria obtained directly from diseased tissue. The writer was assisted in the tests with borax by Mr. J. Matz, and with the tests with bichloride, copper sulphate, carbolic acid and potassium permanganate, etc., by Dr. E. S. Cogan, agents of the Bureau of Plant Industry, United States Department of Agriculture. The canker bacteria have been killed in one minute or less in all tests made with bichloride in water 1-1000, bichloride in dilute denatured alcohol (10%) 1-1000, formaldehyde (2% solution), and carbolic acid (5% solution). They were also killed by a one-half hour exposure to formaldehyde gas, the gas being made with 10 cc of formaldehyde (40% solution) and 5 grams of potassium permanganate to every 13 cubic feet of space.

PATHOLOGICAL HISTOLOGY

According to Miss Hasset[‡] the cells of the host become filled with the bacteria, which exert a stimulating influence on them causing them to enlarge and resulting in the raising of the diseased tissue above that of the normal leaf surface. In later stages some of the cells disintegrate and lesions are formed. The cell contents seem to be more vigorously acted upon than the cell walls and in due time their contents become exhausted. The remaining cell walls become suberized and constitute the cankerous growth characteristic of the disease. Wolf* states that "contrary to Hasse's observations, the bacteria teem around and between the host cells, being present in especially large numbers in the intercellular spaces. When the organism occurs within the cells, one is led to conclude, since they appear to be confined to such cells, that entrance was effected after some mechanical rupture of the host cells." He is of the opinion that infection takes place only through stomata or injured tissue, but Stevens* thinks that infection may take place directly through the epidermis as the leaves were just as readily infected from the upper surface as they were from the lower.

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[*] Quarterly Bulletin, Vol. I, No. 1, p. 9 (1916).

[†] Stevens, H. E.—Citrus Canker III. Fla. Agr. Exp. Sta. Bul. 128, p. 17 (1915).

[**] l. c., pp. 77-78.

[‡] l, c., pp. 98.

ECOLOGY OF THE DISEASE

The occurrence, prevalence, and severity of citrus canker are affected very much by various factors. Two of the factors which seem to have the greatest effect are weather conditions and vitality and vigor of the host.

Weather Conditions

Field and laboratory studies of the disease have demonstrated that it is much more prevalent and severe, and that the incubation period is much shorter during the summer than during the winter. In Florida the humidity and temperature are usually high during the summer, humidity averaging from 50% to 95% and temperature from 65 to 95 degrees F. at the Tropical Laboratory. Local showers are very prevalent and frequently follow one another with such rapidity that the trees do not dry off for long periods of time. During the winter the opposite conditions prevail, the air being dry and cool and showers few with long intervals between them. At Redland the temperature usually ranges from 45 to 85 degrees F. and the humidity from 20% to 90%. Swingle learned that the disease was much more destructive and prevalent in Japan during warm moist seasons than it was during cool dry ones.

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*l. c., pp. 80-81.
**l. c., p. 13.

Vitality and Vigor of the Host.

The vitality and vigor of the host have a marked effect upon the prevalence and severity of citrus canker as well as upon the period of incubation. The disease is much more prevalent and severe upon trees which are in an otherwise thrifty, healthy growing condition than it is upon those which are unthrifty and unhealthy. The period of incubation is much longer when the trees are unthrifty and unhealthy and the disease may remain on such trees in a dormant condition without becoming visible for long periods of time. Anything, such as cultivation and fertilization, which will bring out a vigorous thrifty growth on trees of this kind will also cause the disease to appear, if present, in a visible and typical form, and thus facilitate its discovery and make possible its eradication.

CONTROL

Ever since citrus canker was recognized as a new disease numerous attempts have been made to solve the problem of controlling it.

Since many fungus diseases can be checked by spraying, most of the first attempts at control were applications of various fungicides as the disease was then thought to be of fungus origin. Bordeaux mixture, iron sulphate, ammoniacal copper carbonate, soluble sulphur and other mitxures were tried but they all failed to check the disease.

So-Called "Canker Cures"

Many attempts have been made to cure the disease, mostly by parties unfamiliar with the exact methods of the bacteriologist and hence prone to draw immature conclusions. No experiment of this kind has yet shown successful results.

At the laboratory careful consideration has been given to all plans, methods or materials which have been submitted by private parties as "remedies" for citrus canker. In the case of many of these a knowledge of their nature, coupled with the most perfunctory knowledge of bacteria, showed them at once to be useless. Those which gave even a remote promise of possessing any merit were carefully tested but in no case has any plan or preparation been found to possess any value.

Living canker bacteria have been found in all spots treated with supposed cures at the Tropical Laboratory as well as in canker material sent to the laboratory which was thought to

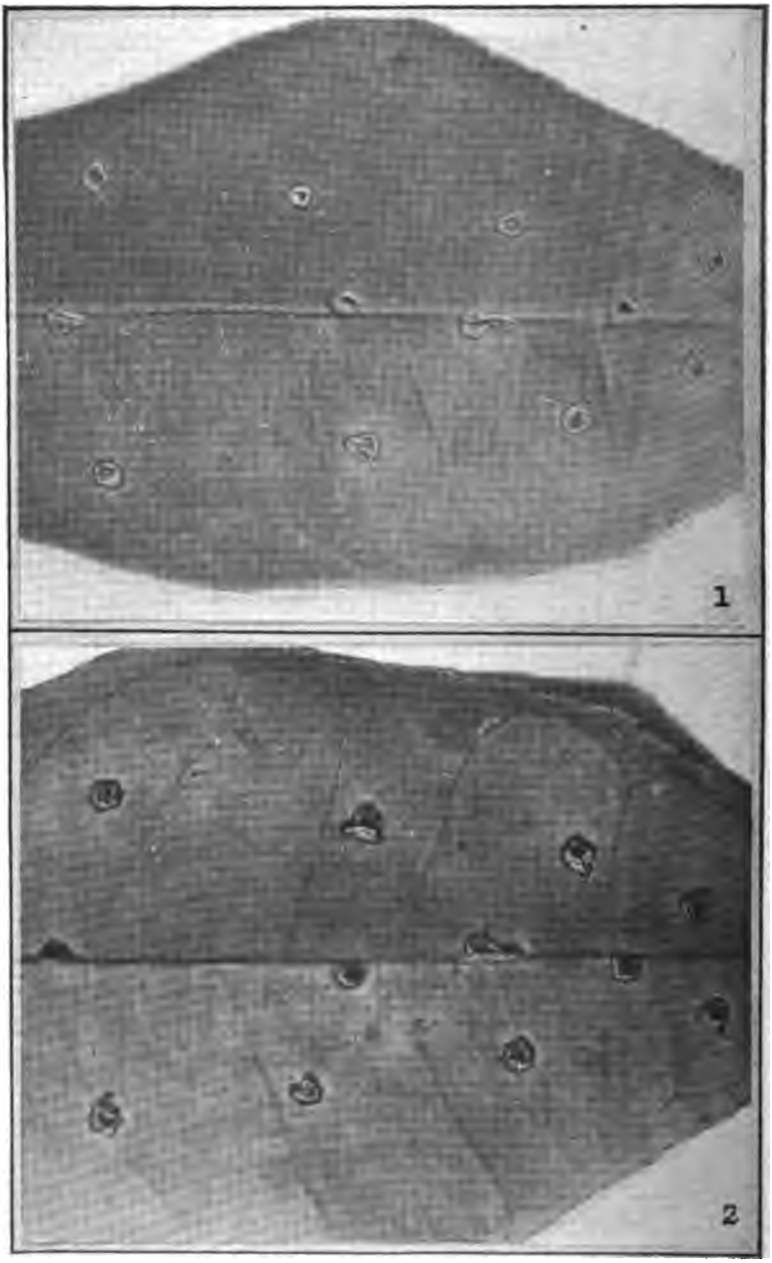

Plate XXII.—Twelve canker infections on a grapefruit leaf produced by introducing canker bacteria into needle pricks made with a sterile needle: 1, upper surface of leaf; 2, lower surface; all enlarged three times (Original).

have been cured. Most of these so-called canker cures are in the nature of liquids which are thought to cure canker by spraying them on the diseased trees. Many substances will change the appearance of canker spots and may cause the dead tissue or entire leaf to drop, but do not kill the canker organisms within the tissues. Even if a substance will kill the canker organisms just as soon as it comes in contact with them, it may be absolutely of no value as a canker cure when sprayed on the infected trees, as the bacteria within the tissues may remain alive after the treatment. For instance, a solution of bichloride in water 1-1000 will kill the canker organisms with which it comes in contact but living colonies of *Bacterium citri* can be readily isolated from infected fruits, leaves, and twigs which have been repeatedly dipped in the solution. Every spot infected with citrus canker contains millions of canker bacteria, each capable of reproducing the disease under favorable conditions and it would be extremely difficult if not impossible to find any substance which would kill all of them without seriously injuring or killing the infected plants.

The disease has been thought by some to be carried in the sap of a tree and various salts including copper sulphate and iron sulphate have been applied to the roots with the hope that they would be taken up by the sap and cure the disease. None of these treatments has checked the disease and it is very unlikely that any substance can be found that will be taken up by the sap and carried to the infected parts and kill all of the canker organisms without killing or seriously injuring the treated plants.

Attempts have been made to cure infected trees by cutting them back, by burning out infected portions, and by pruning back severely, often to the main trunk and a few large limbs, then treating with some disinfectant such as strong Bordeaux paste, solutions of bichloride in alcohol, and carbolinium. None of these treatments was successful as the disease reappeared on most of the treated trees soon after they put out new growth.

Doryland* conducted some experiments on infected nursery stock in the Philippine Islands, using formaldehyde sprays and cutting back in some instances. Soil treatment was also included in the tests. Some success is claimed for the method in preventing spread of the disease but too short a time had elapsed between the treatment of the trees and the writing of the report to be certain as to the final results.

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*Doryland, E. D.—Citrus Canker Investigations at the Singalong Experiment Station. Phil. Agr. Rev., IX, p. 133 (1916).

Exclusion

Prior to the adoption of quarantine rules by the State Plant Board, under authority of the Florida Plant Act of 1915, the principal means of dissemination of citrus canker was by the shipment and movement of citrus nursery trees, either from infected nurseries or nurseries which had been exposed to infection.

On January 1, 1915, the Federal Horticultural Board placed a quarantine on all importations of citrus trees and plants, prohibiting their importation to the mainland of the United States. The introduction of all citrus nursery stock into Florida has been prohibited by the State Plant Board, thus eliminating the chances of any further introductions of the disease from outside sources. In case of infection centers within the State the rules of the Board prohibit the planting of citrus trees within one-half mile of a canker-infected property and prohibit the movement of any citrus tree located within one mile of the boundaries of an infected property. Through the compliance with these rules by the citrus growers in the affected sections, dissemination, even locally, by movement of citrus plants has apparently been stopped, for no case of such dissemination has yet come to light.

Eradication

It was early recognized that the most economical way to handle citrus canker would be to completely eradicate it. As long as the disease exists within the State it will be a continuous expense to the growers of citrus fruits and to the State as a whole as it threatens to greatly cripple if not to completely destroy the citrus industry if allowed to develop unchecked. Even if a remedy were found there would always be a certain amount of expense connected with its application which would greatly decrease the profits of the industry. The only practical way by which the disease can be controlled at the present time is to inspect all of the citrus trees as frequently as possible and completely destroy infected trees as soon as they are found. The infected trees are destroyed by burning them where they stand with an oil spray, using the same kind of an outfit which is used in applying a fungicide. The ground around the tree is also burned for a distance of three feet beyond the utmost spread of the branches. As an additional precaution to kill any canker organisms which may have been washed into the soil and survived the burning, the ground around the burned tree is saturated with a 2% solution of formaldehyde.

All of the work of inspecting and destroying infected trees is carried on by inspectors attired in special suits and under the most rigid precautions which can be devised with reference to disinfection and other sanitary precautions. The disease has already been eradicated from over half of the properties in Florida in which it was found to occur and there seems to be no doubt that a proper continuation of these methods will result in final eradication of the scourge from all of the infected areas.

THE PINEAPPLE BLACK WEEVIL

Another Pest Likely to be Introduced Into Florida

Wilmon Newell

The introduction of citrus canker into Florida has brought home to thousands of citizens the importance of protecting our State against the insects and plant diseases which occur in foreign countries, and sometimes even in countries lying very close at hand. The spiny citrus white fly, a pest probably as destructive to citrus plants as even citrus canker and attacking many non-citrus plants as well, occurs in the Bahamas, Cuba and Jamaica. The Morelos fruit worm and the pink bollworm of cotton occur in Mexico, the avocado weevil in Central America and the Mediterranean fruit-fly in the Bermudas and in nearly all the tropical and sub-tropical countries from which Florida citizens are likely to import trees and plants. Against all of these pests, and many others, the State Plant Board is maintaining as efficient and thorough a quarantine as its resources will permit.

Now comes information regarding a destructive insect of pineapples which occurs in the Above Rocks District of Jamaica, where fully 75 per cent. of the pineapple crop was destroyed by it during the year which ended July 21, 1916. The pest is a black weevil which has been described* by Dr. Guy A. K. Marshall of the British Museum of Natural History as *Metamasius ritchiei*. Through the courtesy of Mr. Archibald Ritchie,

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*Bulletin of Entomological Research.

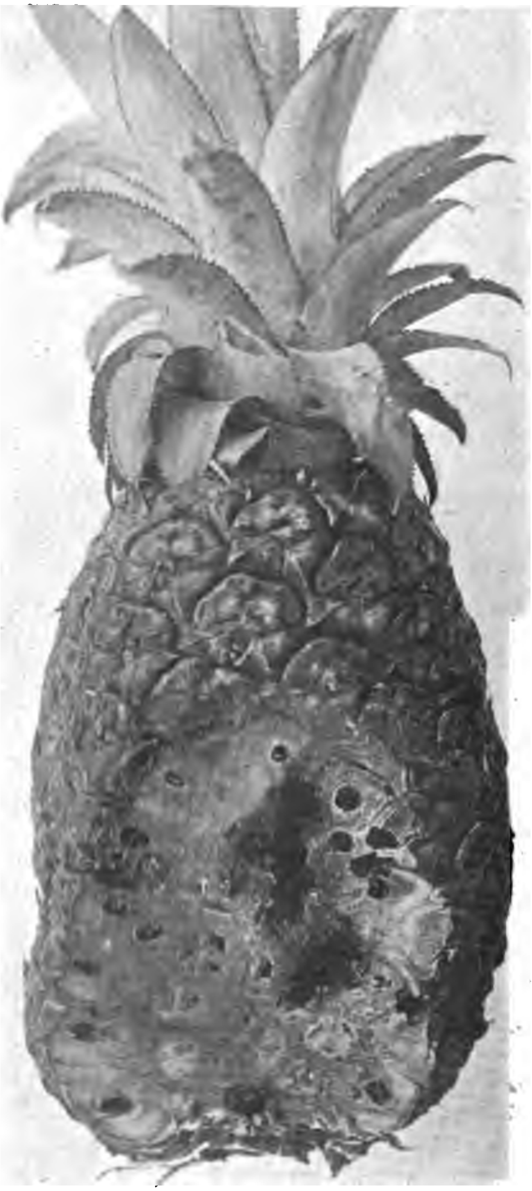

Plate XXIII.—Pineapple destroyed by the grubs of the pineapple black weevil. The holes made by the grubs are plainly visible. (From photo by Archibald H. Ritchie, Government Entomologist of Jamaica.)

Government Entomologist of Jamaica, the writer has been furnished with an account of the damage done by this pest as well as with photographs showing pineapple plants and fruit injured by it.

The weevil is large and black and the female deposits her eggs on or in the leaves and stems of the plant. The larvæ, or grubs, hatching from these eggs tunnel through all parts of the plant both above and below ground. The grub is described as being legless (as are all weevil grubs), yellowish white and with a peculiar, prominent swelling or bump on the posterior third of the body. The attack upon the fruit is thus described by Mr. Ritchie*:

"Upon the pineapple just developing, initial attack is indicated by exudation of pinkish jelly which coagulates in beads or groups of beads.

"The opening of the burrows of the grub may be indicated by the voidance of pine frass of a yellow color.

"The attack may be at any point of the fruit, from the collar of the crown down to the junction of the fruit and stalk.

"The fruit before it is shot from the 'cabbage' may be attacked and hence never develop. This condition might be called 'dead-heart.'

"The fruit may be attacked just after being shot and the decaying brown shell of the fruit is all that remains."

With reference to the manner of attack on the plant itself, Mr. Ritchie's investigation shows that this may be:

"By way of the fruit stalk, the channel leading from the decaying fruit, first attacked, down into the pine proper.

"At the base of the leaf; the younger grubs appear to bore through the base of one or two leaves as indicated by tiny holes, but for the voidance of frass the grub later makes a bigger opening to the exterior and these openings, when the leaves are stripped off, are very conspicuous. The accumulation of frass and jelly down among the leaves is a clear indication of attack.

"The plant may be entered before the fruit is formed and a 'dead-heart' condition results.

"Once entered, the grub proceeds to tunnel out the entire plant and root system with the result that the plant is destroyed and dries out."

The above description is sufficient to show the destructiveness of the pest. The manner in which the pineapples are tunneled by the grubs is shown in Plate XXIII.

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*Journal of the Jamaica Agr. Society, Vol. XX, No. 8, Aug., 1916, pp. 316-318.

No treatment for infested plants has been discovered and as a means of preventing the spread of the pest to new areas the custom has been adopted in the affected district of Jamaica of digging out the infested plants and slashing the fruits open with cutlasses so that the grubs within them can be destroyed by birds, ants, lizards, etc.!

The grubs are readily transferred in pineapple slips. It is known that pineapple slips have been shipped from Jamaica to Cuba and from Cuba pineapple slips are shipped into Florida each season by the carload!

It is even possible that this pest has already reached the pineapple plantations of Florida and all growers of pineapples are urged, for their own protection and that of the industry, to keep a close lookout for indications of the "Black Weevil" in their fields and promptly report any suspicious findings to the Plant Board. The discovery of a destructive pest of this kind would of course be the occasion for an immediate effort at its eradication.

DEPARTMENT OF CITRUS CANKER ERADICATION

The following reports on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, have been compiled by Mr. Frank Stirling, General Inspector:

DECEMBER, 1916*

Citrus grove trees inspected	1,362,610
Citrus nursery trees inspected	5,756,225
Inspectors employed	363
New properties showing infection	4
Total properties showing active infection	12
Grove trees found infected	27
Nursery trees found infected	0
Counties in which active infections were found	3

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914**	13,336
Nursery trees found infected since May, 1914	342,221
Number properties infected to December 31, 1916	441
Properties declared no longer " danger centers "	291
Properties still classed as " infected ", December 31, 1916	150

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*The Plant Commissioner's Annual Report, which will appear in the April number of the Quarterly Bulletin, contains the history and data concerning infections up to December 1, 1916.

**The time at which eradication of citrus canker was commenced by the Florida Growers' and Shippers' League. Statistics as to the number of infected trees and properties prior to that time are not available.

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1916:

1914		1915		1916	
		January	306	January	86
		February	165	February	21
		March	444	March	49
		April	408	April	49
May	108	May	1042	May	338
June	160	June	772	June	450
July	275	July	651	July	349
August	1313	August	1345	August	219
September	767	September	618	September	124
October	565	October	214	October	451
November	773	November	494	November	131
December	366	December	256	December	27

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING DECEMBER 31, 1916*

The following report on the inspection of shipments and importations, at all stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

Ships and Vessels Inspected:		
From foreign ports		359
From U. S. Ports other than Florida		152
From Florida ports		188
Total		699
Shipments Inspected:		
Arriving by water:		
Passed	67	
Treated and passed	25	
Returned to shipper	30	
Contraband destroyed	196	318
Arriving by express or freight:		
Passed	364	
Treated and passed	84	
Returned to shipper	39	
Detained, subject to return by owner	21	
Contraband destroyed	53	561
Total shipments inspected		879

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*The Plant Commissioners' Annual Report, which will appear in the April number, contains a summary of the work in this Department to September 30, 1916.

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of Shipments Infested
Whitefly	Avocado	Florida	2
Whitefly	Citrus	Florida	10
Whitefly	Guava	Florida	2
Whitefly	Jessamine	Florida	2
Whitefly	Privit	Georgia	1
Whitefly	Hibiscus	Florida	2
Whitefly	Coleus	Florida	1
Long scale	Citrus	Florida	3
Purple scale	Citrus	Florida	7
Florida red-scale	Citrus	Florida	1
Florida red-scale	Magnolia	Florida	1
Florida red-scale	Camphor	Florida	2
Chaff scale	Citrus	Florida	1
San Jose scale	Peach	Georgia	1
San Jose scale	Shrub	Georgia	1
San Jose scale	Rose	Georgia	1
San Jose scale	Apple	Georgia	1
San Jose scale	Cherry	Georgia	1
San Jose scale	Plum	Georgia	3
San Jose scale	Peach	Indiana	1
San Jose scale	Pear	Indiana	1
San Jose scale	Peach	Kentucky	1
San Jose scale	Peach	New Jersey	1
San Jose scale	Peach and plum	Missouri	1
Oyster-shell scale	Birch	Maine	1
Florida wax-scale	Citrus	Florida	1
Snow scale	Hibiscus	Florida	3
Snow scale	Shrub	Florida	1
Chrysomphalus sp.	Rose	Virginia	1
Cottony cushion-scale	Coleus	Florida	2
Mango scale	Mango	Florida	1
Dictyospermum scale	Palm	New Jersey	1
Dictyospermum scale	Palm	Pennsylvania	1
Dictyospermum scale	Citrus fruits	New York	2
Oleander scale	Citrus fruits	New York	2
Aspidiotus Britannicus	Laurel	Georgia	1
Soft brown scale	Laurel	Georgia	1
Soft brown scale	Hibiscus	Florida	3
Soft brown scale	Citrus	Florida	1
Putnam scale	Peach and plum	Missouri	1
Diaspis sp.	Peach and plum	Missouri	1
Birch scale	Birch	Maine	1
Fiorinia fioriniae	Camellia	Florida	1
Mealy-bug	Shrub	Cuba	1
Mealy-bug	Citrus fruits	New York	1
Papaya fruit-fly	Papaya	Florida	3
Bamboo borer	Bamboo	Louisiana	2
Peach tree borer	Peach	Missouri	1
Peach tree borer	Peach	Tennessee	1
Peach tree borer	Peach	Georgia	1
Root-knot	Pecan	Florida	1
Root-knot	Peach	Florida	2
Root-knot	Hibiscus	Florida	2
Root-knot	Fig	Florida	3
Root-knot	Vines	Florida	1
Root-knot	Fig	Georgia	3
Root-knot	Rose	Georgia	1
Root-knot	Grape	New York	1

Insect or Disease	Occurring on	From	Number of Shipments Infested
Root-knot	Grape	Georgia	1
Root-knot	Peach	Georgia	3
Root-knot	Peach	Missouri	2
Root-knot	Shrubs	Georgia	2
Root-knot	Laurel	Georgia	1
Root-knot	Plum	Oklahoma	1
Root-knot	Peach	Oklahoma	1
Root-knot	Rose	West Virginia	1
Root-knot	Alamanda	Georgia	1
Root-knot	Alamanda	Florida	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Georgia	2
Crown gall	Peach	Georgia	1
Crown gall	Pear	Missouri	1
Crown gall	Rose	Pennsylvania	1
Crown gall	Rose	Ohio	1
Crown gall	Peach	Oklahoma	1
Withertip	Citrus	Florida	1
Withertip	Citrus	Cuba	2

THE SWEET POTATO ROOT-BORER IN FLORIDA

WILMON NEWELL

Prof. J. R. Watson, Entomologist of the University of Florida Experiment Station, has issued a circular of warning regarding the sweet potato root-weevil, which has recently been found to occur in one of the northern as well as in two southern counties of the State. In many of the sections in other Gulf States, where this pest occurs it has rendered the successful production of sweet potatoes impossible. The sweet potato is perhaps the most important source of food for the poorer people of Florida and destruction of this crop, even in a majority of years, would cause deprivation to those for whom the securing of a livelihood is always difficult.

So serious does this menace to the potato crop appear that the Plant Board, at its meeting on January 8, 1917, authorized an immediate investigation by its Entomological Department to determine how widespread the pest has become in this State, how destructive it is likely to be under Florida conditions and the possibility of restricting its further spread by suitable quarantine measures.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* .... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER .... *Entomologist*
F. M. O'BYRNE .... *Nursery Inspector*
R. A. JEHLE .... *Asst. Plant Pathologist*
FRANK STIRLING .... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

THE PRESENT ISSUE. Even though the first number of The Quarterly Bulletin was devoted entirely to citrus canker, and another article on the same subject appears in this issue, it is not our intention to let this subject monopolize our pages. However, to the citrus growers of the State the subject is a very important and serious matter and most of them doubtless feel that, for their own protection, they cannot know too much about the disease. It is hoped that the general discussion of the disease by Dr. Jehle in this issue, used in conjunction with the colored illustrations which were printed in the October issue, will give every grower a clear understanding of the nature of the disease, how it is spread and more particularly the measures which must be taken—by growers as well as officials—for preventing its spread and for facilitating its final eradication.

The Annual Report of the Plant Commissioner to the State Plant Board is now in press and, upon its completion, will be transmitted by the Board to His Excellency the Governor of Florida. In order that those vitally interested in the work of the Board in eradication and control of various pests and diseases may know what is being done along this line, the Board has directed that the Commissioner's Annual Report be published in the next (April) number of The Quarterly Bulletin. The report will contain, among other things, a summary of the canker eradication work up to November 30, 1916, and of the Port and Railway Inspection work to September 30, 1916. The summaries of the work in these two departments, published in this issue, complete the reports on these departments to December 31, 1916. Future issues of The Quarterly Bulletin will contain reports for the respective quarters, or three-months periods.

THE UNKNOWN CANKER INFECTION. Few people realize the extent of the citrus areas of Florida and the magnitude of inspecting all citrus trees and properties for citrus canker. Everything possible has been done in the way of tracing suspected shipments of nursery stock and most of the centers of infection have been found in this way. Likewise, everything possible is being done to prevent spread of the disease from known centers of infection. The writer has estimated that it would require from three to five years for a force of 500 inspectors to make even one inspection of the citrus properties in Florida. Until this is done the growers cannot feel sure that all centers of infection have been located and the disease brought under control.

Against the undiscovered infection there can be but one safeguard: the application of such sanitary methods on the part of the individual growers that canker can *not* get into their properties, no matter from what source it may come. Laborers, ladders, farming implements, visitors, etc., are all possible carriers of the bacteria which cause citrus canker and if any undiscovered centers of infection do exist it is a certainty that people are daily passing from such centers to healthy properties.

The suggestion, made by the Plant Board a couple of months ago, that all citrus properties should be handled in a sanitary way, has been accepted with enthusiasm in nearly all the important sections. In many neighborhoods laborers are not employed until their persons and clothing are disinfected, ladders and field boxes are disinfected between properties and packing houses have installed dipping vats in which all field boxes are disinfected before they leave the packing house. In addition to such measures being a safeguard against the undiscovered center of canker infection, they tend to prevent the spread of many other diseases, such as scaly bark. A circular fully describing these measures has been prepared and will be sent free on application to the Plant Commissioner.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 April, 1917 No. 3

REPORT OF THE STATE PLANT BOARD FOR THE FISCAL YEAR ENDING APRIL 30, 1916

AND SUPPLEMENTAL REPORTS

LETTER OF TRANSMITTAL

January 2nd, 1917.

To His Excellency,
Sidney J. Catts,
Governor of Florida.

SIR: Herewith is submitted the report of the State Plant Board for the year ending April 30th, 1916, and supplemental report to August 31st, 1916. We request that you submit same to the Legislature.

Respectfully,
STATE PLANT BOARD,
By P. K. YONGE,
Chairman.

REPORT OF STATE PLANT BOARD

The report of the Plant Commissioner, Wilmon Newell, which is hereto attached and to which we invite your careful attention, covers so completely the work of the Plant Board that we deem it unnecessary to refer to any part of it specifically, except as to the matter of appropriations.

GENERAL WORK

We have given very careful consideration to this subject and we are of the opinion that the amount estimated by the Commissioner as necessary for the general work of the Board is not sufficient. The scope of the work contemplated by the Plant Act is very broad and the necessity for developing the work, especially the Department of Nursery Inspection and the Department of Port and Railway Inspection, is urgent. We think that $85,000.00 per annum will be necessary for this work. The additional amount over that suggested by the Plant Commissioner is for salaries and traveling expenses of the heads of departments and for printing. As there is a continuing appropriation of $35,000.00 for this work, we recommend that an additional appropriation of $50,000.00 per annum for the next biennium be made.

CITRUS CANKER ERADICATION

Citrus Canker is one of the most destructive plant diseases known and is far the most serious menace to the Citrus Industry of Florida that we have encountered. The disease destroys the tree it attacks and is easily carried from the infected tree to other trees. It is very difficult to eradicate for the following reasons:

(1) The difficulty of detecting it in its early stages.

(2) A person, bird, insect or any other thing coming in contact with the infection may disseminate it.

(3) It may lay dormant months, sometimes about two years, before being discovered.

For these reasons a strict and long quarantine and frequent inspections are necessary. Notwithstanding the seriousness of the disease and the difficulty of its eradication much has been accomplished towards this end and we believe it can be completely eradicated. In the light of our experience in this work and from present indications we think it will take from two to three years to eradicate it. In arriving at a conclusion as to the probable cost we must carefully consider present conditions and also the danger of further outbreaks of the disease. The Plant Commissioner bases his opinion of what will be required for the next two years on our experience and the cost for the five months ending September 30th, 1916, and this method appears to us to be a reasonable one. The amount expended during this period was $179,671.51 and on this basis $431,211.50 per annum would be necessary. No doubt you will give the subject most careful consideration and we hope you will find it expedient to make the necessary appropriation to continue the work of eradication to a successful conclusion.

STATE PLANT BOARD,
By P. K. YONGE,
Chairman.

REPORT OF THE PLANT COMMISSIONER

Hon. P. K. Yonge, Chairman,
State Plant Board of Florida.

SIR: I have the honor to submit herewith my report on the work of the State Plant Board for the fiscal year ending April 30, 1916, and supplemental reports.

Respectfully,
WILMON NEWELL,
Plant Commissioner.

ORGANIZATION OF THE BOARD

The State Plant Board was created by an Act of the Legislature approved April 30, 1915, this Act being Chapter 6885 of the Laws of Florida, and known by the short title of "The Florida Plant Act of 1915". The Act provided that the State Plant Board should consist of five members, being the same persons who constitute the Board of Control.

The first meeting of the Board was held at Jacksonville on May 4, 1915, and Mr. P. K. Yonge elected Chairman of the Board. At this meeting it was decided that the place of the chief executive officer should be filled temporarily by a special committee, known as the "Advisory Committee", consisting of Mr. P. H. Rolfs, Director of the Florida Experiment Station; Mr. L. S. Tenny, Secretary-Manager of the Florida Growers' and Shippers' League, and Mr. W. J. Krome, of Homestead, Florida. The Advisory Committee was authorized to execute all orders of the Board and to carry out its rules and regulations. As an emergency existed at this time, due to the occurrence of citrus canker in certain parts of the State, rules were adopted by the Board, under the provisions of the Plant Act, looking to the eradication of the disease and to prevention of its further spread.

At the following meeting of the Board, held May 10, 1915, it was decided that the chief executive officer of the Board should be known as the "Plant Commissioner" and that the work of the Board should be divided into four departments, namely, the Departments of Citrus Canker Eradication, Nursery Inspection, Plant Pathology and Entomology. A fifth department, that of

Port and Railway Inspection, was subsequently provided for. This division of the work has been found thoroughly practical and under this plan has gone steadily forward. The work of the respective departments is mentioned on subsequent pages.

ADVISORY COMMITTEE

From May 4, 1915, until August 14, 1916, when they resigned, the members of the Advisory Committee, serving without remuneration, gave unstintingly of their time and efforts in forwarding the work of the Board. Mr. Krome assumed full charge of the canker eradication work in Dade County, Mr. Tenny supervised the eradication work in the remainder of the State and Mr. Rolfs supervised the work of nursery inspection.

A Plant Commissioner was elected by the Board at its meeting on July 12 and commenced his duties on August 24, 1915. Owing to the magnitude of the work confronting the Board the members of the Committee continued to serve, acting in an advisory capacity to both the Board and the Plant Commissioner. The thanks of the entire State are due these gentlemen for their services, so efficiently rendered, at a time when the State's principal fruit industry was threatened by citrus canker, the most destructive plant disease ever known in the history of horticulture.

RULES AND REGULATIONS

In accordance with the provisions of the Plant Act the Board has from time to time adopted and published rules and regulations for preventing the introduction of dangerous insect pests and plant diseases into the State, for preventing the further dissemination of such as already occurred within the State and for eradicating certain plant diseases of extremely dangerous nature. These rules were published, as adopted, in the Circulars of the Board.

April 30, 1915, to April 30, 1916

Circulars Nos. 1 to 9, inclusive, were published between May 1, 1915, and February, 1916. Circular No. 10, issued March 23, 1916, contained all rules adopted by the Board up to that time, and Circular No. 11 contained additional regulations of the Board adopted at its April meeting.

May 1, 1916, to October 31, 1916

During this period Circulars 12 to 16, inclusive, containing rules and regulations adopted at the May, June, July, August, September and October meetings of the Board, were issued. In addition, Circular No. 17, issued October 31st, contained an Order issued by the Third Assistant Postmaster General on October 24, 1916, providing for the inspection, by the Plant Board, of mail shipments of plants and plant products arriving at Florida post offices.

Circulars 10 to 17, inclusive, contain all rules, regulations and public notices of the Board in effect October 31, 1916.

OFFICES AND LABORATORIES

The Plant Act provides that the offices of the Plant Board shall be located at the University of Florida at Gainesville. Through the courtesy of the University officials, rooms were assigned to the Plant Board on the second floor of Language Hall and these were occupied in September of 1915. At the present time four rooms are occupied by the Plant Commissioner, his assistants, stenographers and clerks, one room by the Nursery Inspection Department and one by the Department of Entomology. In addition to these, storerooms and an entomological laboratory have been established in the attic of Language Hall and a special room for the inspection of plant shipments, with facilities for fumigation, disinfection, etc., has been equipped in the basement of the same building.

Even these facilities are very inadequate for handling the executive work incident to the Board's working staff of upwards of four hundred employees, correspondence with nurserymen, fruit growers and farmers of the State and the laboratory investigation which is a necessary part of the eradication and control work being conducted in connection with many pests and diseases in various parts of the State.

TROPICAL LABORATORY

The necessity for scientific studies of citrus canker as a means of perfecting methods for facilitating its eradication, and for the further purpose of finding, if possible, a remedy for the disease, was recognized by the Board immediately upon its organization.

The establishment of a special laboratory for these investigations was made possible by the generosity and public spirit of the South Dade County Fruit Growers' and Truckers' Association. The Association erected at Redland, Dade County, a capacious building to be used jointly as an auditorium and laboratory. Practically one-half of this building was turned over to the Plant Board for laboratory work, the only expense to the Board being the equipment of the laboratory with the necessary apparatus. Dr. R. A. Jehle was elected Assistant Plant Pathologist to the Board on July 12, 1915, and, pending completion and equipment of the laboratory, he devoted his time to field investigations of citrus canker. The laboratory was formally opened November 27, 1915. Investigations have been steadily pursued since that time under Dr. Jehle's supervision. Some valuable results have thus far been obtained, to which reference is made on a subsequent page under the heading of "Department of Plant Pathology".

ERADICATION OF CITRUS CANKER

The first case of citrus canker found in Florida was discovered in Jefferson County on September 30, 1912, by the Inspector of Nursery Stock, Dr. E. W. Berger. At that time the disease was new and totally unknown. Specimens collected by Dr. Berger at Monticello on September 30, 1912, were subsequently found to be identical with the disease which later came to be known as "citrus canker". In July of 1913, the same disease was found in a nursery in Dade County and though every effort was made by the Inspector of Nursery Stock, under existing laws and with the limited resources at his command, to prevent its spread, the disease appeared in some of the citrus groves in that County in the spring of 1914.

The sudden appearance of a new and destructive disease was unprecedented. Dr. Berger's keen realization of the possibilities this disease possessed for creating havoc to the citrus industry and his activity in calling attention of the growers to it was largely responsible for the prompt measures taken to suppress it. Had as much as two more years passed without adequate legislation and appropriations for fighting the disease, citrus canker would without doubt have secured such a wide distribution in the State as to have made the cost of eradication run into the millions of dollars, if indeed it would not have been rendered impossible.

In May of 1914 the Florida Growers' and Shippers' League, realizing the gravity of the situation, contributed funds for a preliminary investigation of the trouble and Mr. L. S. Tenny, Secretary-Manager of the League, assumed personal charge of the work. Mr. Frank Stirling was employed at the expense of the League to make a survey under direction of the Inspector of Nursery Stock to determine the extent to which the disease had spread. By June of 1914 the growers of Dade County realized that a disease of extremely virulent nature had appeared in many of their groves. Additional funds were appropropriated by the Growers' and Shippers' League and additional inspectors were employed to wage warfare on the disease. Attempts to control the disease by means of sprays and by cutting out infected leaves, twigs and branches and treating the remaining portions of the trees with disinfectants proved ineffective. In July, 1914, the growers abandoned hope of curing infected trees and adopted a campaign of eradication consisting of the destruction of the infected trees by fire.

Additional contributions were made by the growers of Dade County, these aggregating in the neighborhood of $30,000 up to the time of passage of the Plant Act in April, 1915. The Florida Growers' and Shippers' League expended $17,770.58; citrus growers in other sections of the State, transportation companies, marketing agencies, etc., contributed approximately $30,000 more, and His Excellency, Governor Park Trammell, contributed $1000 out of his contingent fund.

During the summer of 1914, the same disease, though its identity was unknown, was found to be destroying citrus plantings on Santa Rosa Peninsula in Walton County. Here too, the growers tried various remedial measures to no avail and, without any knowledge of what was transpiring at the same time in Dade County, employed Mr. Harold Mowry as inspector for their Association and adopted the plan of destroying by fire all infected trees discovered.

By the end of 1914 the disease had also been found in Broward, Brevard, Escambia, Lee, Palm Beach, Pasco and Pinellas Counties, apparently in restricted areas.

The United States Department of Agriculture was constantly in touch with the situation in Florida and other Gulf States, and as a result of information furnished to Congress by the

Honorable Secretary of Agriculture that body made an appropriation of $35,000, available February 1, 1915, for the purpose of investigating the possibility of eradicating the disease. Of this sum, $24,254.53 was expended by the Bureau of Plant Industry in Florida and the remainder in the other Gulf States.

The seriousness of this menace to the citrus industry of Florida was generally recognized throughout the State when the Legislature convened in the spring of 1915 and the necessity of adequate legislation for dealing with the existing emergency, as well as the self-evident need for protection of the agricultural and horticultural industries of the State against the introduction of additional destructive pests and diseases, was largely responsible for the passage of the Florida Plant Act. This Act was approved April 30, 1915, and in addition to creating a State Plant Board and providing the legal facilities for dealing with such situations, made available a continuing appropriation of $35,000 per annum for the work of the State Plant Board and a special fund of $125,000 for the eradication of citrus canker.

April 30, 1915, to April 30, 1916

Within four days after the approval of the Plant Act the Plant Board organized and assumed charge of the canker eradication work throughout the State, as well as of the nursery inspection work.

The Bureau of Plant Industry, United States Department of Agriculture, co-operated in the canker eradication work until June 30, 1915, at which time the Congressional appropriation of $35,000 became exhausted, the official expense of the work being borne jointly by the Bureau and the State Plant Board from May 1, 1915, to June 30, 1915.

The Florida Growers' and Shippers' League continued to take an active part in the eradication work during 1915 and, subsequent to the passage of the Plant Act, expended $7,249.04 in this work.

From July 1, 1915, until February 29, 1916, the State Plant Board conducted the eradication work without assistance from the Federal Government, defraying the expense thereof out of the appropriations made by the Legislature in connection with the passage of the Plant Act.

At a mass meeting of citrus growers held at Gainesville, Florida, October 6, 1915, a committee, consisting of Messrs.

D. C. Gillett (Chairman), L. B. Skinner, J. H. Ross, L. D. Jones, and Geo. S. McClure, was appointed and instructed to place before Congress the need of Federal aid in dealing with this disease. Similar committees, appointed from Texas, Louisiana, Mississippi and Alabama, in which States the disease was now known to occur, co-operated with the Committee from Florida in placing before Congress the seriousness of the situation.

Although the disease had not appeared in California or Arizona, the citrus growers and members of Congress realized the importance of eradicating it and co-operated with the committees from the Gulf States in presenting the matter to Congress. As a result of these representations and through the endorsement of the Honorable Secretary of Agriculture, David F. Houston, an appropriation of $300,000 for canker eradication in the United States was included in the Urgent Deficiency Bill approved February 28, 1916. Immediately upon this fund being made available the Bureau of Plant Industry resumed active co-operation with officials of the States in which canker occurred, Florida included. An additional sum of $250,000 was included by Congress in the Agricultural Bill, approved August 11, 1916.

Up to the end of February, 1916, there had been expended out of the Plant Act Special Fund $108,415.36. During March and April, 1916, the greater part of the expense of this work in Florida was defrayed by the Bureau of Plant Industry out of the Federal appropriation mentioned. During these two months $32,751.13 was expended in the eradication work. Of this sum, $576.69 was defrayed out of the Plant Act Special Fund and $32,174.44 out of the Federal appropriation.

The following schedule shows the disbursements, by months, out of the Plant Act Special Fund during the fiscal year:

Month	Salaries	Traveling Expenses	Supplies	Total for Month
May, 1915	$ 2,269.74	$ 464.02	$ 553.36	$ 3,287.12
June, 1915	3,496.71	983.64	868.91	5,349.26
July, 1915	11,437.69	1,299.73	810.73	13,548.15
August, 1915	12,563.32	1,188.26	535.10	14,286.68
September, 1915	12,623.54	1,911.26	902.61	15,437.41
October, 1915	11,061.97	2,417.09	1,018.61	14,497.67
November, 1915	10,506.15	1,837.36	939.74	13,283.25
December, 1915	7,597.50	1,812.16	132.75	9,542.41
January, 1916	7,698.18	1,685.35	346.76	9,730.29
February, 1916	7,635.33	1,588.77	229.02	9,453.12
March, 1916	30.00	135.13	215.33	380.46
April, 1916	144.15	41.62	10.46	196.23
Total for fiscal year				$108.992.05

May 1, 1916, to September 30, 1916

During this period the cost of the canker eradication work in Florida was $179,671.51, of which sum $2,484.22 was defrayed out of the Plant Act Special Fund and $177,187.29 by the Bureau of Plant Industry out of the Federal appropriations.

It appears that, up to September 30, 1916, a total of at least $432,462.44 was expended in the eradication of citrus canker in Florida, the sources of this amount having been as follows:

Through the Inspector of Nursery Stock, prior to April 30, 1915, estimated*	$ 1,350.29
Contributions by growers and citizens of Dade County, 1914-1915, estimated	30,000.00
By Florida Growers' and Shippers' League, prior to April 30, 1915	17,770.58
By Florida Growers' and Shippers' League, subsequent to April 30, 1915	7,249.04
Contributions by citrus growers of Florida (exclusive of Dade County), transportation companies, marketing agencies, etc., estimated	30,000.00
Out of Governor's Contingent Fund, 1914-1915	1,000.00
First Federal appropriation, February to June, 1915	24,254.53
Plant Act Special Fund, April 30, 1915, to February 29, 1916	108,415.36
Plant Act Special Fund, March 1, 1916, to April 30, 1916	576.69
Plant Act Special Fund, May 1, 1916, to September 30, 1916	2,484.22
Federal appropriation, through Bureau of Plant Industry, March 1, to April 30, 1916	32,174.44
Federal appropriation, through Bureau of Plant Industry, May 1, to September 30, 1916	177,187.29
Total to September 30, 1916	$432,462.44

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*In connection with the general work of inspecting and quarantining nurseries.

TRAINING OF INSPECTORS

The necessity for employing only trained inspectors in the campaign against citrus canker was self-evident from the time the disease was first discovered in Dade County. The inspection methods were largely developed by the growers of Dade County during 1914 when they were carrying on the work at their own expense and the growers themselves were serving as volunteer inspectors.

The readiness with which the disease was transmitted from one citrus tree to another resulted in a practice of disinfecting the hands by all parties who examined the infected trees. This was followed shortly by disinfection of the workmen's clothing by spraying it with a disinfecting solution. Following this it was decided that still greater safety would be secured by wearing a union overall suit and removing this entire suit and disinfecting it whenever the grower left a canker-infected property. The use of the overall suit shortly led to the development of a one-piece inspection suit made of white cloth to cover the entire clothing of the inspector. This suit, worn with leggings, shoes and a special hat, all of which, together with the hands, arms and faces of the inspectors, are disinfected when they leave properties under inspection, has become the standard inspection outfit worn by all inspectors.

The men engaged in the eradication work in Dade County in 1914 obtained a knowledge of citrus canker and the methods of detecting it by actual experience, and these men became the nucleus of the inspection force employed by the Growers' and Shippers' League in 1914.

With the creation of the Plant Board, April 30, 1915, the inspection force which had been previously employed by the Florida Growers' and Shippers' League was taken over in its entirety. During the summer of 1915 additional inspectors were acquired and were, in all cases, trained by serving apprenticeships in the canker-infected properties under the tutorage of men who had previously been thoroughly trained. These apprenticeships were, in all cases, served by the prospective inspector at his own expense and the completion of a satisfactory apprenticeship was a necessary prerequisite to his appointment as an inspector. With the extension of the canker eradication work into new territory and the imperative need of additional inspectors in the spring of 1916, it was seen that there were not sufficient facilities for training by the apprenticeship method the large number of inspectors that would be required. Accordingly, a so-called "citrus canker school" was established at Gainesville. Applicants whose previous training, experience, and moral character indicated that they possessed the qualifications necessary to the making of competent inspectors were admitted to the two-weeks classes of instruction at their own expense.

The first of these classes commenced on March 3rd and was concluded on March 14th, 1916, twelve inspectors being trained. A second class held from March 16th to April 1st, 1916, trained 13 inspectors. The third class, April 3rd to 15th, trained 12; the fourth class, May 1st to 13th, trained 36 inspectors; and the fifth class, June 6th to 17th, trained 65 inspectors, making a total of 138 inspectors specially trained in these classes.

The course of training given these men consisted of lectures covering all phases of citrus canker eradication work; the methods of disinfecting employed under various conditions and circumstances; the Florida Plant Act of 1915 and the rules and regulations of the Plant Board relative to the work of inspectors and quarantines; methods of differentiating citrus canker from other diseases of citrus plants; the relation between the Federal Department of Agriculture and the State organization in conducting the canker eradication work and numerous other subjects vitally connected with the work of canker eradication. The lectures were supplemented by actual field practice in the inspection of citrus properties in the vicinity of Gainesville. Each prospective inspector was required to pass an eyesight test, as well as an examination at the end of his training course.

It was only by means of these classes of instruction that it was possible to secure as many trained inspectors as were imperatively needed for the canker eradication work.

It is a pleasure to report that the men trained in these classes have shown themselves as proficient as those who were trained as apprentices in the field. While there is perhaps little choice between the two methods of training, the greatest efficiency would be attained if all inspectors were enabled to take the course of training in addition to a field apprenticeship.

FIELD ORGANIZATION

In sections where a considerable number of inspectors are employed the inspectors work in squads of four in charge of an experienced foreman. The foreman is directly responsible to the District Inspector, who may have charge of from five to fifteen squads. The territory assigned to each District Inspector is dependent upon conditions and the extent of infected properties with which he has to deal. In some cases a district consists of less than a county and in other cases it consists of from two to three counties. The District Inspectors are directly responsible to the Plant Commissioner. Only the most experienced and tried men are assigned to detached duty.

In addition to the inspection force a limited number of employees are designated as Grove Supervisors. The principal duty of the Grove Supervisor is to secure the co-operation of the owners of canker-infected properties in so conducting the work in their properties that danger of spreading the disease will be reduced to a minimum. In all cases, the men selected for the position of Grove Supervisor are experienced citrus growers who have received adequate training on the canker inspection forces.

LOCATING THE CENTERS OF INFECTION

The introduction of citrus canker into Florida, as well as its dissemination from one locality to another within the State, had been through the medium of nursery stock shipments from infected nurseries.

One of the first problems confronting the Plant Board was to find out what nurseries were, or had been, infected, to what points these nurseries had shipped citrus trees and whether these trees had developed the infection after reaching the growers who received and planted them. It had been determined by the former Inspector of Nursery Stock, Dr. E. W. Berger, that four citrus nurseries within the State were infected and that these nurseries had made shipments prior to the discovery of canker in them. It was also found that an infected nursery in another State had made citrus shipments into Florida. From the nurseries themselves, from transportation companies and from all possible sources, lists were obtained of these shipments. It was found that a total of 3,131 shipments of "dangerous" citrus nursery stock, comprising a total of 338,512 trees, had been distributed in Florida by these nurseries. These shipments had gone to 427 towns or villages in 51 counties of the State. When one considers that many shipments were to dealers or agents who re-distributed the trees in small lots, that growers frequently divided shipments with their friends or neighbors and that winter visitors to the State frequently ordered trees and presented them to relatives or friends, the magnitude of the task involved in finding and inspecting these 338,512 trees can be appreciated. The task did not stop with finding the trees and giving them one inspection, for, having been exposed to the danger of infection, they were likely to be carrying the disease in dormant form and might not develop it in visible form until many months afterwards. It was therefore considered necessary to make repeated inspections of these trees for from one to three years after they were planted before being assured of their safety. Several months of work and heavy expense were involved in finding these trees and *all* of them have not yet been found. However, the first inspection of those which could be located brought to light 62 centers of infection distributed through 21 counties. Fifty-six, or 90 per cent, of these infections were found on shipments made by one nursery firm.

In this connection it should be remembered that all of these shipments were made prior to the passage of the Plant Act. No case of distribution of canker on shipments of citrus trees made since the passage of the Plant Act has yet come to light. In other words, the quarantines imposed by the Plant Board in conjunction with infected properties seem to have effectually closed this avenue of dissemination.

When the dangerous nature of these "exposed" trees was fully realized through the finding of canker on an average of one tree out of every one hundred and eight of them, it became self-evident that the interests of both grower and State would best be served by their destruction, without waiting for the disease to manifest itself. However, the Plant Act authorized the forcible destruction of only such trees as actually showed infection. No matter how complete the evidence that a tree had been infected and would presently develop the disease it could not legally be destroyed until it showed the canker lesions or until its owner gave consent for its destruction.

An active campaign of education was accordingly launched by means of which the owners of these trees were apprised of their dangerous nature and their permission solicited for the destruction of them. In this work, growers' associations, boards of trade and individual growers of prominence gave their time and efforts freely. The cost which either the State or the Government would incur by continuing the inspection of these trees for from one to four years' time, before they could be considered as safe, was an added argument for their destruction.

Up to April 30, 1916, 146,753 of these dangerous trees (including the ones which showed infection) were destroyed with the owners' consent. Between May 1 and November 30, 1916, consent was secured for the destruction of 31,360 more, making a total of 178,113, out of the total of 338,512, destroyed up to November 30, 1916. There are, accordingly, 160,399 of these trees, the location of which is known, which must still be considered as dangerous and the periodical inspection of which must be continued for at least a year longer, unless the owners will in the meantime consent to their destruction.

QUARANTINES IN AND AROUND INFECTED PROPERTIES

It was early recognized that some form of quarantine would be necessary to prevent the spread of canker from infected properties and as all primary infections had been found due to shipments and movements of citrus trees which had been exposd to infection, the plan of preventing the movement of nursery stock from areas in which the disease occurred naturally suggested itself. Prior to the passage of the Plant Act, the Inspector of Nursery Stock had withheld inspection certificates from all nurseries located in localities where the disease was known to occur, thus establishing what was virtually a local or " district " quarantine.

At a conference of grove owners and members of the Board at Redland, Dade County, on June 18, 1915, a plan of quarantining was arrived at which gave promise of preventing dissemination of the disease without the hardships attendant upon quarantines applying to specified counties or districts considerable areas of which were apparently free from the disease. At this time the Board adopted its Rule 5, which declared every property infected with citrus canker to be the center of an infected and dangerous zone, this zone extending a mile in every direction from the boundaries of the infected property and within which center and zone all citrus trees and plants were declared to be plants likely to carry and disseminate citrus canker. The planting or movement of citrus trees and citrus budwood within such zone was prohibited. Upon the adoption of this rule local quarantines which had previously been imposed were repealed.

Rule 5 prevented the movement and distribution of nursery stock which was located in dangerous proximity to canker infections, prevented the distribution of canker from one point to another within the quarantined area on citrus trees and facilitated eradication by prohibiting the planting of any additional host plants, namely, citrus trees, within the dangerous area. Rule 5 effectually eliminated what had been, up to that time, the greatest factor in distributing the disease, namely, the movement of citrus trees which were actually infected but on which, in the majority of instances, the disease had not developed to the point of being visible.

As the eradication work progressed it became evident that the quarantine in the area extending one mile in every direction from an infected property could be modified when danger of further outbreaks within that area had apparently ceased. Owing to the length of time which canker could remain dormant it was self-evident that the infected property would have to be kept under inspection and close observation for several months before the quarantine surrounding it could be lifted. The condition of the trees in the property as to vigor and growth and the manner in which the property had been handled by the owner were also found to be important factors bearing on the probability of further outbreaks of the disease.

No quarantines of this character were raised by the Board until its meeting on October 11, 1915. At this meeting careful consideration was given by the Board to the records and history of infected properties which had shown no canker infections for periods varying from ten to sixteen months and in the case of properties wherein the Board felt assured no further cases of the disease would appear the quarantine was raised in so far as it affected the surrounding properties to a distance of one mile. As the ability of the canker bacteria to persist and multiply in the soil had by this time been established, the Board, when lifting these quarantines, specified that there should be no further planting of citrus in the infected properties until permission therefor had been granted by the Board.* In other words, the Board, when raising the quarantine surrounding an infected property, did not declare that the disease had been completely eradicated therefrom, but merely expressed the opinion that the property was no longer a "danger center" from which outbreaks of canker were likely to occur.

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*Up to the time of printing this report such permission has not been granted by the Board in any case.

DISTRIBUTION OF THE DISEASE IN FLORIDA

April 30, 1915, to April 30, 1916

At the time the Plant Act was approved, April 30, 1915, citrus canker was known to occur in the counties of Brevard, Broward, Dade, Escambia, Jefferson, Lee, Palm Beach, Pasco, Pinellas and Walton.

With the active inauguration of the Plant Board work infections previously existent were rapidly brought to light. During May of 1915, the disease was found in DeSoto and Santa Rosa Counties, during June in Baker County, during July in St. Lucie County, during August in Marion County, during September in Hillsboro and Seminole Counties, during October in Bay County and during December in Duval County. During January canker was found in Suwannee County, but during the months of February, March and April, 1916, infections were not found in any additional counties.

In some of the counties mentioned only one infected property was found, while in others the infected areas were more extensive and of a very serious nature. All of these infected centers were found as a result of systematically running down and inspecting citrus nursery stock shipments which had been made from canker-infected nurseries prior to the passage of the Plant Act. Approximately ninety per cent of the primary infections* were traced to shipments made by one nursery firm.

While the number of counties in which the disease had been found was relatively large, an adequate idea as to the extent of the infections can be had only by considering the number of individual properties in which the infection was found. The number of properties, in the entire State, known to be infected on April 30, 1915, was 243.

The number of additional infected properties discovered, as well as the number of infected properties declared by the Board to be no longer " danger centers ", during the fiscal year, is shown below:

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*By "primary infection" is meant the first infection of canker occurring in a locality. All primary infections of canker thus far found in the State were due to shipments of nursery stock from infected nurseries.

Month	Number of properties found infected*	Number infected properties declared no longer " danger centers "
May, 1915	11	....
June, 1915	17	....
July, 1915	28	....
August, 1915	33	....
September, 1915	17	....
October, 1915	9	89
November, 1915	6	1
December, 1915	7	5
January, 1916	3	....
February, 1916	0	....
March, 1916	7	2
April, 1916	1	....
Totals	139	97

Summary, April 30, 1916

Properties infected April 30, 1915	243	
Found infected between April 30, 1915, and April 30, 1916	139	
Total properties infected to April 30, 1916		382
Declared no longer " danger centers "		97
Properties still classed as infected on April 30, 1916		285

May 1, 1916, to November 30, 1916

During the months of May, June, July, August and September no infections were found in counties not previously infected. During October an infection of long standing was discovered in Lake County. This infection was traced to two shipments of citrus nursery stock from an Alabama nursery in the spring of 1913* which had, fortunately, been planted in adjoining properties. The number of properties found infected for the first time and the number declared no longer " danger centers " during this period are shown below:

Month	Number of properties found infected	Number infected properties declared no longer " danger centers "
May, 1916	10	....
June, 1916	9	....
July, 1916	9	18
August, 1916	9	2
September, 1916	7	1
October, 1916	11	163
November, 1916	5	6
Totals	60	190

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*Namely, properties not previously known to be infected.

*The exact date of one of these shipments cannot be determined. It may have been made in 1912.

Grand Summary, November 30, 1916

Properties infected to April 30, 1916	382	
Additional properties found infected between May 1, and November 30, 1916	60	
Total properties infected to November 30, 1916		442
Properties declared no longer danger centers to April 30, 1916	97	
Declared no longer danger centers between May 1, and November 30, 1916	190	
Total	287	
Less properties showing subsequent infection	5*	
No longer danger centers, November 30, 1916		282
Properties still classed as infected on November 30, 1916		160

The following statement shows the total number of citrus trees, both infected and exposed to infection, which have been destroyed in the course of the canker eradication work up to the present time. Trees which had been exposed to the infection, but which had not shown visible canker, were in all cases destroyed by the owners or with their permission. The number of nursery trees given includes seedlings and plants in seed beds.

	Infected Trees Destroyed		" Exposed " Trees Destroyed	
Period	Grove Trees	Nursery Trees	Grove Trees	Nursery Trees
Prior to April 30, 1915	5,650	320,406	16,327	354,200
Apr. 30, 1915, to Apr. 30, 1916	5,597	21,364	42,910	2,185,634
May 1, 1916, to Nov. 30, 1916	1,931	448	33,399	6,780
Total	13,178	342,218	92,636	2,546,614

It is significant that the number of infected trees during the above periods steadily decreased.

The progress made in eradication of the disease is also indicated by a comparison of the number of infected properties on April 30, 1915, and on April 30 and November 30, 1916. On April 30, 1915, when the Plant Board came into existence, 243 infected properties were known, and many other infections were in existence but were as yet undiscovered. Despite the discovery of 139 additional infected properties during the following twelve months the number " infected " at the end of the fiscal year, April 30, 1916, was but 285. From May 1 to November 30, 1916, the number of properties declared to be no longer danger centers was nearly four times as great as the number of newly infected properties found during the same period and on the latter date the number of "infected" properties was but 160. Stated in another way, eradication of the disease is believed to be complete in 282, or 63½ per cent of the total 442 properties in which canker has been found up to the present time.

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*In three of the properties declared no longer danger centers, in which canker infection subsequently appeared, circumstances indicated infection from outside sources; in the remaining two re-infection was undoubtedly due to hold-over dormant infections or to soil infections in the properties themselves.

The progress in eradication is also indicated by Figure 1, which shows the number of infected trees found in the State each month from May, 1914, to date. Several factors have operated to determine the number of infected trees found each month. For example, the periods of growth which the citrus trees usually undergo in midsummer and again in November are favorable to a rapid spread of the disease. A reduction in the number of inspectors employed has always been followed by an increase in the number of infections. On the other hand, the number of infections found during the periods of dormancy are lower than during periods of growth and an increase in the inspection force has always been followed by a decrease in the number of infections, even in the midst of the growing periods.

Figure 2 shows the number of canker-infected properties found in the State up to the end of any given month: likewise the number of infected properties declared no longer danger centers up to the corresponding date.

The preceding data, though greatly condensed, is sufficiently convincing to justify the conclusion that the continuation of the present campaign against citrus canker in Florida must inevitably result in its eradication from the State. Final eradication is assured if sufficient funds are constantly available so that the work may continue without interruption, under efficient management and with such energy and speed as to prevent any material spread of the disease while, at the same time, the remaining infections are being stamped out.

LEGAL ACTIONS

On account of the active co-operation of the citrus growers and because of the practically universal support which the Plant Board has received in its efforts to enforce the quarantine measures necessary to the eradication of the disease, there has been but little occasion for resort to the courts.

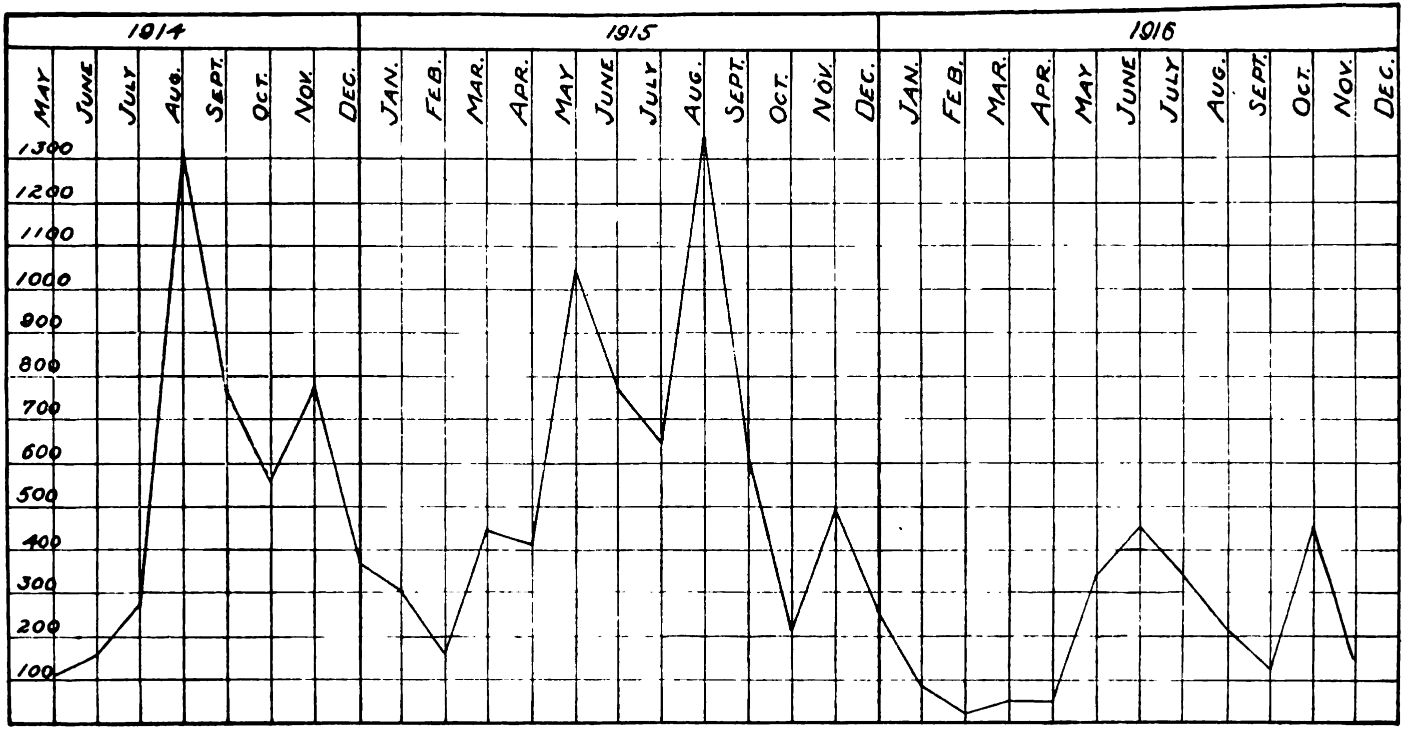

Fig. 1. Diagram showing the number of canker-infected grove trees found in Florida each month from May 15, 1914 (when eradication work was begun by the Florida Growers' and Shippers' League) to November 30, 1916.

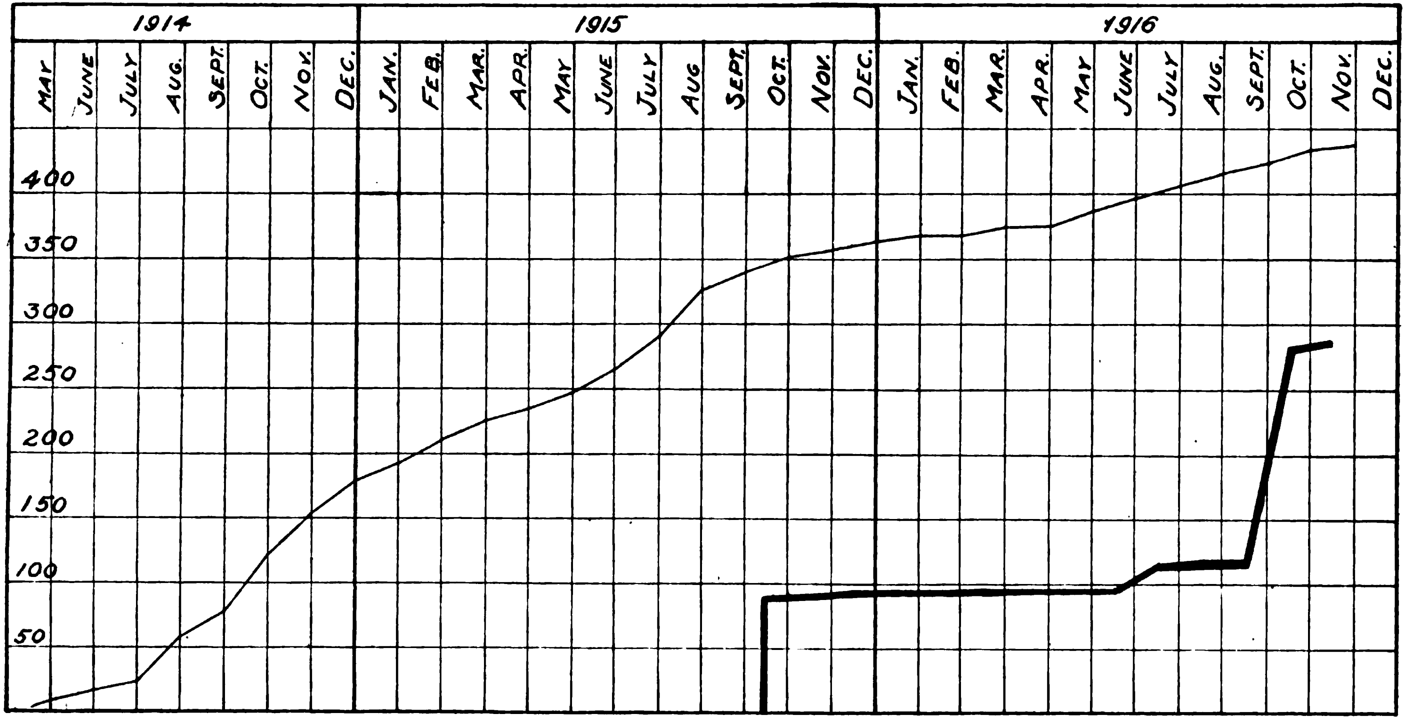

Fig. 2. Comparison of infected properties and properties declared no longer danger centers in Florida at different dates. The light line shows the total number of canker-infected properties found in the State up to the end of any given month. The heavy line shows the number of canker-infected properties declared by the Plant Board, up to corresponding dates, as being no longer danger centers. (When these two lines meet, in a diagram of this character, eradication of the disease from the State will have been completed.)

APRIL 30, 1915, TO APRIL 30, 1916

Civil

During this period four owners of canker-infected properties sought by injunction to restrain the agents of the Plant Board from destroying canker-infected trees in accordance with the provisions of the Plant Act. The Circuit Court issued a preliminary injunction in each of these cases. Upon hearing, these injunctions were dissolved.

In another case the owner of a citrus grove requested an injunction restraining the inspectors of the Board from inspecting his property for citrus canker, alleging that the Florida Plant Act of 1915, authorizing such inspection, was unconstitutional. The Circuit Court of Dade County held the Plant Act to be constitutional and sustained a demurrer to such bill, and upon an appeal, the Supreme Court affirmed the decision of the Court below.

The State Plant Board sought by injunction to restrain the owner of a canker-infected property from interfering with agents of the Board in destroying canker-infected trees as provided for by the Plant Act. A preliminary injunction was issued, the terms of the injunction were alleged by the Board to have been violated and the defendant cited for contempt.

Criminal

Warrants were issued charging two owners of canker-infected properties with refusing to destroy, or to permit destruction of, canker-infected trees. At the end of the fiscal year one of these cases was still pending. In the other case the defendant died before being tried.

A warrant was issued charging the owner of a canker-infected property with picking, packing and shipping citrus fruit from said infected property in violation of the Plant Board rules prescribing the sanitary precautions for handling of such fruit. Preliminary hearing was indefinitely postponed upon payment of costs by defendant and assurances being given of future co-operation with the Plant Board.

A warrant was issued charging a nurseryman with removing plants from a canker-infected property. Case pending at the close of the fiscal year.

An owner of a canker-infected property planted citrus trees therein in violation of Rule 5 of the Board. Upon information being filed against this party he plead guilty and was fined $25.00 and costs.

Warrants were issued charging two owners of citrus properties with assault, arising out of the inspection of citrus properties by agents of the Plant Board. One of these was nol-prossed upon assurances of future co-operation with the Board; the other was pending at the close of the fiscal year.

May 1, 1916, to November 30, 1916

Civil

During this period but one case was brought against the Board. Certain nurserymen whose citrus nurseries were located within one mile of property which the Plant Board had by resolution declared to be canker-infected property and hence under quarantine by the provision of Rule 5 of the Plant Board, petitioned the lower court for a decree requiring the Board to abolish its Rule 5 and to require said Board to permit the sale and distribution of citrus nursery stock which, under its rules, was declared to be exposed to danger of infection. To this the attorneys for the Plant Board filed a demurrer. The lower court overruled this demurrer, but the Supreme Court of the State reversed the decision, sustaining this demurrer. In its decision the Supreme Court held that the bill of complaint failed to show that the State Plant Board in making and enforcing Rule 5 had exceeded its authority, and that therefore a court of equity would not be warranted in requiring the Board to abolish or modify its rule.*

Criminal

Warrants have been issued charging four parties with planting citrus trees in areas within which such planting was prohibited by rules of the Plant Board because of danger of infection by citrus canker. These cases are pending at the time of this report.

Warrants have been issued charging two parties with having moved nursery stock without a certificate of inspection attached, as required by the Plant Act. These cases are also pending.

CO-OPERATION

The Plant Board has received the unstinted co-operation and support of the Florida Growers' and Shippers' League, the Florida Citrus Exchange, marketing agencies and local growers' associations.

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*The cost to the Plant Board of defending this case, including attorneys' and witness fees, time of its employees, traveling expenses, etc., amounted to $1238.80.

The University of Florida Experiment Station, through its Director, Prof. P. H. Rolfs, and several members of its staff, has rendered valuable aid. The assistance of Prof. H. E. Stevens, Plant Pathologist of the Station, in furnishing to the Board and its agents the results of his exhaustive investigations of citrus canker is particularly worthy of mention.

Members of the Faculty of the University of Florida cheerfully contributed their services in the training of inspectors for the canker eradication work. Through the courtesy of President A. A. Murphree, the Plant Commissioner and his assistants have also been supplied with office and laboratory room and their work facilitated in many ways.

During those periods in which the canker eradication work has been conducted in intimate co-operation with the Bureau of Plant Industry, United States Department of Agriculture, the most harmonious relations have existed between the Plant Board staff and the officials of the Bureau. The latter have been untiring in their efforts to facilitate in every way possible a successful campaign against the disease in Florida. Special mention should be made of the interest displayed in this work by the Honorable Secretary of Agriculture, David F. Houston, and the active part taken by Dr. K. F. Kellerman, Assistant Chief of the Bureau of Plant Industry.

Much of the success which may have been attained thus far is in large measure due to the generous support and assistance received from all quarters.

DEPARTMENT OF NURSERY INSPECTION

The nursery is a necessary feature in the horticultural industries, for it is the place in which trees are produced and grown for planting in the groves and orchards. The nursery could not be dispensed with in the development of any fruit industry of commercial importance. However, the nursery, besides being the distributing center for trees and plants, is also the distributing center of all diseases and insect pests to which the grove or orchard trees are subject. Healthy orchards can be insured only by the use of healthy nursery stock, and the latter cannot be insured save by a very efficient and painstaking inspection system which will not only detect dangerous diseases and insects in the nursery, and prevent their distribution to planters, but which will go even further and protect the nurseries themselves against infestation from outside sources. Such a system has been developed by the Plant Board and is confidently believed to be at least the equal of any in the United States.

Practically all of the pests which the pecan growers, peach growers, citrus growers and other horticulturists are now compelled to combat have been introduced into their plantings on nursery stock in past years when adequate nursery inspection was not provided by the State. As there are many destructive diseases and insects—such as citrus canker, scaly bark, cottony cushion-scale, Dictyospermum scale, California red scale, camphor thrips, pecan die-back, etc.—that are not yet generally distributed over the State and as the introduction of additional dangerous enemies can be prevented only by an adequate inspection of both importations and nurseries, the importance of the nursery inspection work of the Board is self-evident.

The first official inspection of nursery stock in Florida was provided for by an Act of the Legislature approved May 23, 1911, the execution of this Act being placed in the hands of the Board of Control. As but $3000.00 per annum was appropriated for this work, which sum had to cover the salary, office expenses and traveling expenses of the one inspector and as the nurseries of Florida during this period contained not less than twelve million trees, the inadequacy of the inspection service at that time is self-evident. The Inspector of Nursery Stock did the best he could with the facilities at his disposal, but it was a physical impossibility for one man, regardless of his efficiency or energy, to annually inspect more than a very small per cent of twelve million trees.

This arrangement continued until the passage of the Florida Plant Act of 1915, immediately following which the nursery inspection work was taken over and entirely reorganized by the Plant Board.

From April 30 to June 1, 1915, the former Inspector of Nursery Stock, Dr. E. W. Berger, assisted by Prof. P. H. Rolfs of the Advisory Committee, supervised the work of nursery inspection. On May 11, 1915, the Board elected Mr. F. M. O'Byrne as Nursery Inspector and he assumed the duties of this position June 1, 1915.

Among the many striking results of the nursery inspection work the following will serve as examples:

On three occasions citrus canker has been discovered in nurseries by assistant inspectors and distribution of trees from these nurseries prevented.

Scaly bark has been discovered in thirteen localities where it was not previously known to exist, the Board being thereby enabled to take steps for preventing its further dissemination from these centers.

Camphor thrips was discovered in seven nurseries and its distribution from these centers of infestation prevented.

The Dictyospermum scale* was discovered in Florida, and nurseries so located as to be exposed to infestation by this new pest were placed under quarantine.

Foot rot was discovered in three nurseries and these placed under quarantine.

INSPECTION WORK

April 30, 1915, to April 30, 1916

During the fiscal year which ended April 30, 1916, 697 nurseries were inspected. The total number of nursery inspections made was 1,061. The acreage embraced in the 697 nurseries was as follows:

Citrus	1,651	acres
Pecan	471½	acres
Ornamental and general	321	acres
Total	2,443½	acres

The amount of nursery stock (number of trees) in the 697 nurseries inspected was as follows:

Citrus—			
Budded grapefruit	1,822,991		
Budded orange	3,057,699		
Other budded varieties	1,853,953		
Unbudded seedlings	9,995,001		
Total citrus stock		16,729,644*	
Under quarantine April 30, 1916 (for various reasons)		754,016	
Marketable citrus stock April 30, 1916			15,975,628
Pecan—			
Budded	1,784,325		
Seedlings	1,737,975		
Total pecan stock		3,522.300	

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*Known to be, in certain European countries, particularly Spain, the most destructive scale-insect affecting citrus trees.

*Dade County not included.

Pecan stock under quarantine April 30, 1916		150,500	
Marketable pecan stock			3,371,800
Peach—			
Budded	102,680		
Seedlings	96,750		
Total peach stock		199,430	
Under quarantine April 30, 1916		12	
Marketable peach stock			199,418
Plum—			
Budded	22,400		
Seedlings	25,550		
Total		47,950	
Under quarantine April 30, 1916		000	
Marketable plum stock			47,950
General and Ornamental		2,157,793	
Under quarantine April 30, 1916		3,162	
Marketable			2,154,631
Total plants in nurseries recorded April 30, 1916		22,657,117	
Total plants in nurseries under quarantine April 30, 1916		907,690	
Total marketable stock in nurseries recorded April 30, 1916			21,749,427

May 1, 1916, to August 31, 1916

During this period 922 inspections of nurseries were made. A total of 333 nurseries, newly established or not previously known to the Department, were placed under inspection. The acreage in these 333 nurseries was as follows:

Citrus	148½ acres
Pecan	6½ acres
Ornamental and general	24¼ acres
Total	176¼ acres

The amount of nursery stock growing in these "new" nurseries was as shown below:

Citrus—		
Budded grapefruit	125,657	
Budded oranges	253,071	
Other budded varieties	55,530	
Unbudded seedlings	1,409,182	
Dade County citrus nursery stock*	2,037,008	
Total		3,880,448
Stock in new nurseries under quarantine September 1, 1916		2,196,225
Marketable citrus stock in newly inspected nurseries**		1,684,223

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*The inspection of citrus stock in Dade County is under the direction of the Dade County branch of the Canker Eradication Department.

**At the present time citrus nursery stock in Dade County is permitted moved under package certificate only.

Pecan—			
Budded	22,250		
Unbudded	19,250		
Total pecan stock		41,500	
Under quarantine September 1, 1916		000	
Marketable pecan stock in newly inspected nurseries			41,500
General and ornamental		116,858	
Under quarantine September 1, 1916		16,409	
Marketable general and ornamental stock in newly inspected nurseries			100,449
Total plants in new nurseries		4,038,806	
Under quarantine September 1, 1916		2,212,634	
Total marketable stock in new nurseries September 1, 1916			1,826,172

QUARANTINES IMPOSED

The discovery of any especially injurious insect or disease in a nursery is the occasion for placing that nursery under quarantine and preventing all movement of stock therefrom. The quarantine may be of short or long duration, according to the promptness with which the owner of the nursery eradicates the pest or disease in question or satisfactorily reduces the danger of infestation to his plants. In no case is the quarantine lifted until all the stock in the nursery is, in the light of all available information, made safe from infection.

April 30, 1915, to April 30, 1916

During the fiscal year quarantines were imposed on 104 nurseries, the reasons therefore being stated below:

Quarantined on account of:	Number of nurseries quarantined
Canker in nursery	3
Located in quarantine zone	16*
Being contact properties**	4
San Jose scale	7
California red scale	4
Camphor thrips	7
Excessive whitefly and scale	63
Excessive citrus scab infection	1
Scaly bark	1
Total	104

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*Three nurseries were partly within the quarantined area. They destroyed all stock within the quarantined zone, making possible the release of their remaining stock.

**A citrus property which has been entered by people, teams, implements, or other things which have previously been in a canker-infected property.

May 1, 1916, to August 31, 1916

During this period, quarantines were imposed as follows:

Quarantined on account of:	Number of nurseries quarantined
Canker in nursery	1
Located in quarantine zone	25
Being contact properties	4
San Jose scale	8
California red scale	6
Camphor thrips	7
Excessive whitefly or scale	137
Excessive scab infection	4
Scaly bark	2
Foot rot	3
Dictyospermum scale	5
Total	202

INSPECTION CERTIFICATES ISSUED

Upon the nursery passing a satisfactory inspection the owner is supplied, upon request, with certificate tags permitting the sale and shipment of stock from his nursery. The certificate tags are serially numbered and the nurseryman is required to account for each tag furnished him by mailing to the Nursery Inspector a duplicate " invoice " listing the stock sold or shipped under that tag, together with the name and location of the party receiving same. The Department therefore has what is presumably a complete record of all trees moved from one place to another in the State. In case a dangerous disease, as for example, citrus canker, is discovered in a nursery, the trees *previously* shipped from that nursery can be located and inspected.

Incidentally, these records afford the most accurate statistics ever compiled regarding the nursery industry of any State.

April 30, 1915, to April 30, 1916

During this period certificate tags were issued to 424 Florida nurseries, 47 individuals, 12 nursery-stock dealers and to 67 nurseries located in other states. In other words, 550 firms and individuals were authorized to market nursery stock, previously inspected and passed, in Florida.

The number of certificate tags issued is shown below:

Regular tags	146,500
Stock-dealers' tags	4,800
Package tags	5,571
Scaly-bark tags	4,600
Florida permit tags	17,090
Total tags	178,561

May 1, 1916, to August 31, 1916

During this period, certificates were issued to 87 Florida nurseries, 20 individuals, 1 nursery-stock dealer and 14 nurseries in other states; total, 122. The number of certificate tags issued was as follows:

Regular tags	36,400
Stock-dealers' tags	1,100
Package tags	791
Scaly-bark tags	5,455
Florida permit tags	2,007
Total	45,753

NUMBER OF SHIPMENTS

The records of the Department afford the following interesting data on the amount of nursery stock moved within, into and out of Florida during the fiscal year which ended April 30, 1916:

Number of shipments made by Florida nurseries	33,750
Number of shipments made into Florida by nurseries in other States	5,400
Number of States into which Florida nurseries shipped	48
Number of foreign countries into which Florida nurseries shipped	28
Number of shipments made by Florida nurseries into foreign countries	230
Number of States from which shipments were made into Florida	28

MISCELLANEOUS

Experimental work is not contemplated by the Board except where such work is necessary for the development or improvement of methods for the control or eradication of plant diseases or insect pests, the prosecution of experimental work, *per se*, being considered within the province of the University of Florida Experiment Station.

The advantage of citrus growers being provided with trees practically free from citrus scab has made evident the desirability of nurserymen being required to produce trees essentially free from this disease. Before imposing this requirement upon the nurserymen, however, it is necessary to demonstrate that a satisfactory control of the disease on nursery stock is both possible and practicable. With this in view the Nursery Inspection Department established, during 1915, a citrus nursery of 3600 seedlings and commenced experimental spraying with various fungicides. Severe drouth, immediately following the planting of the seedlings, resulted in the loss of many of them, necessitating replantings before the nursery could be made ready for experimental work. The experiments are now under way and give promise of yielding satisfactory results.

The Department has co-operated with the Department of Entomology in securing and furnishing to growers colonies of the Australian lady-bird beetle for control of the cottony cushion-scale. During the fiscal year ending April 30, 1916, assistant nursery inspectors collected for this purpose 354 of the lady-bird beetles, and between April 30 and August 31, 1916, 551, or a grand total of 905; a sufficient number to bring about prompt control of the cottony cushion-scale in at least 1,000 acres of citrus groves.

The work of the Department has been presented to the public through addresses before association meetings, the Citrus Seminar, articles in the press of the State and by correspondence. Not the least valuable of the services rendered by the Department has been direct advice to nurserymen as to the particular means by which they could prevent infection or infestation of their nursery stock, thus protecting their investments as well as those of their customers.

GRAND SUMMARY

The inspection work done by the Department, from the creation of the Plant Board, April 30, 1915, to August 31, 1916; as well as the amount of marketable stock in the Florida nurseries on August 31, 1916, is shown in the following summary covering the sixteen-months' period:

Total number of nurseries inspected			1,030
Total number of inspections made			1,983
Total acreage of stock in nurseries listed			2,619¾
Citrus nursery stock:			
Budded grapefruit	2,146,815		
Budded oranges	3,752,385		
Other budded varieties	1,269,701		
Unbudded seedlings	9,404,183		
Dade County citrus	2,037,008		
Total citrus nursery stock in State		18,610,092	
Citrus nursery stock under quarantine August 31, 1916		3,579,607	
Marketable citrus stock in Florida nurseries			15,030,485
Total general and ornamental stock		2,274,651	
Under quarantine, August 31, 1916		72,954	
Marketable general and ornamental stock			2,201,697
Pecan buds	1,806,575		
Pecan stock	1,757,225		
Total pecan stock		3,563,800	
Under quarantine, August 31, 1916		422,805	
Marketable pecan stock			3,140,995

Peach buds	114,960		
Peach stock	96,750		
Total peach stock		211,710	
Under quarantine, August 31, 1916		18,912	
Marketable peach stock			192,798
Plum buds	22,400		
Plum stock	25,550		
Total plum stock		47,950	
Under quarantine, August 31, 1916		6,700	
Marketable plum stock			41,250
Total plants in Florida nurseries		24,708,203	
Under quarantine, August 31, 1916		4,100,978	
Marketable plants in Florida nurseries, August 31, 1916			20,607,225

Certificate Tags Issued

Total Florida nurseries receiving tags	511
Individuals receiving tags	67
Stock dealers receiving tags	13
Out-of-State nurseries receiving tags	81
Total	672

DEPARTMENT OF PORT AND RAILWAY INSPECTION

Protection of the agricultural and horticultural industries against the further introduction of destructive pests and diseases was one of the principal objects of the Florida Plant Act of 1915.

It is significant that citrus canker has not obtained a foothold in California, where a horticultural quarantine service has been maintained for thirty years. Canker-infected nursery stock has been several times intercepted by the California quarantine inspectors and the freedom of the California citrus industry from canker thus far can be ascribed only to the success of that State's quarantine inspection.

There had been expended in the campaign of eradicating canker in Florida, up to September 30, 1916, approximately $432,462.44* from all sources. This amount expended in preventing the *introduction* of this disease would have maintained a system of efficient port and railway inspection for over 30 years.

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*See page 66.

During the autumn months of 1915, an assistant nursery inspector was detailed for short periods to examine incoming shipments of nursery stock at Jacksonville. This preliminary inspection work revealed the fact that comparatively few of the nurseries shipping stock into Florida from other states were complying with the Florida Plant Act and many shipments were brazenly consigned to Florida points without even being accompanied by inspection certificates of any kind. Many of these shipments were found infested with injurious insects and diseases.

The urgent necessity for organizing the Plant Board forces in the fight against citrus canker during the summer of 1915 unavoidably delayed inauguration of the port and railway inspection work. This was commenced, however, by the appointment on December 13, 1915, of Mr. W. N. Hull as semi-volunteer deputy inspector at Miami. This was followed by the appointment of deputy inspectors at Pensacola on January 15, 1916; at Jacksonville and Tampa on January 24, 1916; and at Key West on March 23, 1916. Most of these deputy inspectors had received previous training both in the citrus canker eradication work and in the nursery inspection department, while the remaining ones were selected on account of special fitness due to their previous experience in similar lines of work.

Many shipments of plants infested with common, more or less destructive, pests and diseases have been intercepted, and much more material not actually showing infection, but considered dangerous because of its origin, has been prevented delivery in the State.

On one occasion a shipment of citrus budwood, from a canker-infected property in another State, was intercepted while on its way to a Florida citrus nursery. It is not impossible that the stoppage of this one shipment, by preventing subsequent expenditures for stamping out canker outbreaks which might have resulted had the shipment reached its destination and infected the nursery in question, saved the State more than the entire port and railway inspection work would cost for several years.

Upon inauguration of the port and railway inspection service arrangements were made with the Federal Horticultural Board of the United States Department of Agriculture whereby the deputy inspectors of the State Plant Board received appointments as agents of the Horticultural Board with authority to enforce all Federal rules and regulations relative to the importation of plants and plant products. While the State Plant Board must necessarily assume the expense of all inspection, the work is greatly facilitated by reason of the deputy inspectors being Federal appointees, particularly as this arrangement makes possible a close co-operation between the inspectors and the customs officials at all the ports of entry. The customs inspectors have, without exception, rendered cheerful and valuable co-operation and assistance in the inspection of all importtations subject to the rules of the Federal Horticultural Board.

It is a pleasure to report that the officials, as well as local representatives, of the steamship and railway companies and of the Southern Express Company have offered our inspectors every facility for inspecting shipments and have in addition been diligent in securing compliance, upon the part of their employees and connections, with the regulations governing such shipments. In the few instances where shipments have been moved in violation of some rule of the Board it has been found that such movement was due to misunderstanding or ignorance of the requirements and steps have in all cases been promptly taken to remedy any dangerous conditions which may have been created by these violations.

The work accomplished by this Department is shown by the following summaries:

December 13, 1915, to April 30, 1916

Ships and vessels inspected:		
From foreign ports	166	
From United States ports other than Florida	52	
From Florida ports	152	
Total vessels inspected	370	
Shipments inspected:		
Arriving by water:		
Passed	67	
Treated and passed	6	
Returned to shipper	2	
Contraband destroyed	40	
		115
Arriving by express or freight:		
Passed	319	
Treated and passed	9	
Returned to shipper	16	
Detained, subject to return by owner	12	
Contraband destroyed	29	
		385
Total shipments inspected		500

Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of shipments infested
Whitefly	Citrus	Florida	3
Whitefly	Citrus	Cuba	2
Whitefly	Begonia	Cuba	1
Whitefly	Begonia	Florida	1
Long scale	Citrus	Florida	1
Purple scale	Citrus	Florida	1
Purple scale	Hibiscus	Cuba	1
Florida red scale	Citrus	Jamaica	1
San Jose scale	Oleander	Mexico	1
San Jose scale	Oleander	Guatemala	1
Cottony cushion-scale	Citrus	Cuba	1
Cottony cushion-scale	Citrus	Mexico	1
Rufus scale	Citrus	Cuba	1
Latania scale	Latania Palm	Illinois	1
Diaspis sp	Raspberry	Tennessee	1
Soft scale	Palm	Louisiana	1
Red spider	Rose	Cuba	5
Elm tree borer	Elm	North Carolina	1
Peach-borer	Peach	Indiana	1
Camphor-thrips	Camphor	Florida	2
Root-knot	Peach	Florida	2
Root-knot	Fig	Florida	1
Root-knot	Fig	Texas	1
Root-knot	Fig	Georgia	4
Root-knot	Fig	Alabama	1
Root-knot	Peach	South Carolina	2
Root-knot	Peach	Georgia	1
Root-knot	Elderberry	Florida	1
Root-knot	Elaeagnus	Pennsylvania	1
Root-knot	Blackberry	Iowa	1
Citrus scab	Citrus	Cuba	1
Citrus scab	Citrus	Florida	1

May 1, 1916, to September 30, 1916

During this period the work of this Department was continued without interruption. A summary of the inspections is here given:

Ships and vessels inspected:	
From foreign ports	356
From United States ports other than Florida	172
From Florida ports	429
Total vessels inspected	957
Shipments inspected:	
Arriving by water:	
Passed	89
Treated and passed	17
Returned to shipper	23
Contraband destroyed	203
	332

Arriving by express or freight:

Passed	319
Treated and passed	65
Returned to shipper	27
Detained, subject to return by owner	53
Contraband destroyed	54
	518
Total shipments inspected	850

Principal Pests and Diseases Intercepted

Insect or Disease	Occurring on	From	Number of shipments infested
Whitefly	Citrus	Florida	3
Whitefly	Jessamine	Florida	2
Whitefly	Privit	Florida	1
Whitefly	Hibiscus	Florida	1
Whitefly	Jessamine	Georgia	1
Whitefly	Citrus	Cuba	2
Whitefly	Citrus	Honduras	1
Long scale	Citrus	Florida	2
Purple scale	Citrus	Florida	8
Purple scale	Citrus	Cuba	1
Florida red scale	Mango	Florida	1
Chaff scale	Citrus	Florida	2
Chaff scale	Shrubs	Cuba	1
California black-scale	Poinsettia	Florida	1
California black-scale	Jessamine	Florida	1
San Jose scale	Pear	Florida	1
San Jose scale	Rose	Florida	1
Oyster-shell scale	Maple	Pennsylvania	1
Turtle-back scale	Jessamine	Florida	1
Florida wax-scale	Mango	Florida	1
Howard's scale	Gooseberry	Wisconsin	1
Snow scale	Hibiscus	Florida	1
Snow scale	Soursop	Cuba	2
Snow scale	Soursop	Mexico	1
Chrysomphalus oleae	Palm	Georgia	1
Cottony cushion-scale	Citrus	Cuba	1
Cottony cushion-scale	Citrus	Mexico	2
Cottony cushion-scale	Citrus	Florida	3
Rufus scale	Cutting	Cuba	1
Mealy-bug	Coleus	Michigan	1
Mealy-bug	Rose	Florida	1
Mealy-bug	Sugar Apple	Cuba	1
Aphids	Geraniums	Florida	1
Strawberry leaf-roller	Strawberry	Wisconsin	1
Red spider	Rose	Cuba	1
Papaya fruit-fly	Papaya	Florida	1
Papaya fruit-fly	Papaya	Florida	2
Root-knot	Poinsettia	Florida	1
Root-knot	Fig	Florida	2
Root-knot	Austral'n Silk Oak	Florida	1
Root-knot	Cassava	Florida	1
Root-knot	Chrysanthemum	Florida	1
Root-knot	Peach	Florida	2
Root-knot	Hibiscus	Florida	3
Root-knot	Jessamine	Florida	1
Crown gall	Peach	New York	1
Phomopsis sp.	Mango	India	1
Melanose	Citrus	Florida	1

As the deputy port and railway inspectors also examine and inspect shipments of trees and plants enroute from one point to another within the State a check is secured upon the shipments made by nurseries holding the certificates of the Plant Board. Any misuse of these certificates is quickly detected. Many uncertified shipments, frequently infested, between points within the State have been intercepted. Where such material is apparently free of injurious pests and diseases and the evidence at hand indicates that it has not been exposed to infection it is passed and permitted to proceed to the consignee, while the consignor, on the other hand, is courteously advised by mail as to the rules of the Board requiring the certification of trees and plants prior to their shipment.

BOLL WEEVIL AND PINK BOLL-WORM QUARANTINES

Enforcement of the Board's rules relative to the quarantine on shipments likely to disseminate the cotton boll weevil comes within the work of this Department.

Prior to the establishment of a Plant Board, the Board of Control, through the Inspector of Nursery Stock, established a quarantine on cotton seed, cotton seed hulls, and other products likely to carry the cotton boll weevil from infested territory into the portion of Florida not yet reached by this insect. This quarantine, in an improved form, was continued by the State Plant Board.

The boll weevil has two methods of distribution. One is by annual migratory flight, by means of which the insect usually advances from 30 to 40 miles into new territory. The other is distribution in cotton seed, cotton seed hulls, Spanish moss and certain other products shipped from the weevil-infested territory to other cotton-growing areas. While no human agency can prevent the annual migration of the boll weevil into new territory, it is gratifying to know that this pest has been prevented, by means of the Plant Board's quarantines, from taking advantage of express, railway and water shipments to increase its range of destructiveness. While it is quite certain that all the cotton-growing sections of Florida will eventually be invaded by this insect, the Plant Board will continue to impose all possible obstacles to the spread of the weevil, thus protecting the cotton-growing sections not yet infested just as long as possible.

The provisions of this quarantine are found in Rule No. 18 of the Board.

To prevent commercial interests from taking advantage of the restricted movement of cotton seed and cotton seed hulls to advance prices on these commodities the Board, in December, 1915, devised a plan by which cotton oil mills located in weevil-free territory could receive and mill cotton seed from weevil-infested sections without danger of disseminating the boll weevil, such milling being done under the inspection of Plant Board inspectors.

At the close of the cotton-growing season of 1915 the eastern limit of the boll weevil-infested territory was in Hamilton, Madison, and Taylor Counties. During the late summer and autumn of 1916 the weevil, by means of its annual migratory flight, occupied additional territory to the eastward, the eastern limit of the infested territory in November, 1916, running through the Counties of Nassau, Duval, Clay, Bradford, Alachua and Levy. The exact limits of the infested territory were carefully determined by inspectors of the Plant Board, by means of actual field examinations, as a basis upon which the quarantined area was established.

As there are still several thousand acres of land normally devoted to cotton-growing in the area not yet invaded by the weevil the wisdom of continuing the present quarantine is self-evident.

The recent discovery of the pink boll-worm in Mexico has caused considerable alarm among cotton growers throughout the entire South. This pest, which evidently originated in India, is much more destructive than the boll weevil, and there is no reason for not supposing that its introduction into the Gulf States would result in the practical ruin of the cotton industry. This insect is readily transmitted in shipments of cotton seed from infested areas, and while the United States Department of Agriculture, through the Federal Horticultural Board, is maintaining along the Mexican border an effective quarantine against shipments of cotton seed from Mexico, the deputy inspectors of the State Plant Board are keeping a rigid watch for the arrival of any cotton seed from Mexican points on steamers arriving at the ports of this State.

GYPSY AND BROWN-TAIL MOTH QUARANTINE

The Gypsy moth and brown-tail moth, pests occurring in the

New England States and against which a vigorous campaign is being waged by the United States Department of Agriculture as well as by the several States infested, are pests capable of being introduced into Florida with commercial shipments of various kinds. As these insects are very destructive in certain European countries in which the climatic conditions, are practically the same as those of Florida, there is no reason for not supposing that they would be equally as destructive here.

Although all material likely to transmit these pests is carefully inspected by agents of the Department of Agriculture before it is allowed to leave the infested territory, it is deemed advisable to take even further precautions against infested material being shipped into Florida.

With the aid of the United States Department of Agriculture a list has been compiled of the shipments of trees, boxbands and similar materials made during the past few years from New England points to Florida. During the summer of 1916, Deputy Inspector George B. Merrill was detailed by the Plant Commissioner to make inspections of the forest and ornamental plants on all premises where such shipments had been received or used. This work embraced the inspection of 43 premises, located in or near 24 towns, in 17 Counties of the State. It is a matter for congratulation that no evidences of either pest were found by Mr. Merrill.

SUMMARY

The occurrence of the Morelos fruit worm and the pink bollworm of cotton in Mexico, the avocado weevil in Central America, the spiny citrus whitefly in Jamaica and the Bahamas, the pineapple borer in Jamaica, the Gypsy and Brown-tail moths in New England and the Mediterranean fruit fly in Bermuda, the Azores, France, Spain, Hawaii and many other sub-tropical countries, citrus canker in the other Gulf States and brown rot of lemons and oranges in California, make it imperative that the Port and Railway Inspection service not only be continued but that it be made much more thorough than is possible with the funds at present available.

Of the pests and diseases mentioned above, but one, citrus canker, has thus far secured even a temporary foothold in Florida. Introduction of any of the others would mean to the State the same menace and the same expense for eradication now being experienced in the case of citrus canker. Indeed, it is doubtful if some of the pests mentioned could be eradicated at any cost, once they become established. The Mediterranean fruit fly, for example, has never been eradicated in any of the countries where it has become established, despite appalling expenditures and the most desperate efforts on the part of governmental officials and experts.

An efficient quarantine service, to keep these destructive agencies permanently out of our State, is therefore imperative and funds thus expended will constitute insurance of the most valuable kind.

DEPARTMENT OF ENTOMOLOGY

At its first meeting, the Plant Board elected Dr. E. W. Berger, former Inspector of Nursery Stock, as Entomologist. As a Nursery Inspector was not provided for at that time, it was necessary for Dr. Berger, working in conjunction with Prof. P. H. Rolfs of the Advisory Committee, to continue the nursery inspection work until Mr. F. M. O'Byrne assumed the duties of Nursery Inspector on June 1, 1915. The Entomologist was without regular assistance in his office, except for stenographic help, until January 3, 1916. Upon the latter date, Mr. A. C. Mason, after election by the Board, assumed the duties of temporary assistant to the Entomologist.

At the time of Dr. Berger's appointment, this Department, like all other Departments of the Plant Board, was without equipment, the laboratory apparatus, collections, etc., which had been used by the Inspector of Nursery Stock having belonged to the Florida Experiment Station or to himself. It was necessary first of all to equip the Entomological Department with microscopes, glassware, scales, insecticides, etc., and to construct an insectary and laboratory in the attic of Language Hall for the carrying on of the principal work of this Department. A general laboratory for identifying and preserving specimens, and containing the office of the Entomologist, was equipped on the second floor of Language Hall.

Three principal lines of work have been conducted by the Entomological Department; namely, the growth and distribution to citrus growers of the red Aschersonia, or red whitefly fungus, used for control of the whitefly; distribution of colonies of the Australian lady-bird beetle, for control of the cottony cushion-scale, and experiments made in the attempt to devise a satisfactory treatment for camphor trees infested with the camphor thrips.

RED WHITEFLY FUNGUS

For some years past citrus growers in Florida have been accustomed to inoculate the whitefly larvae on the citrus trees with this parasitic fungus by spraying the trees with water in which had been mixed leaves from groves where the fungus occurred. This method, while giving the desired results so far as control of the whitefly is concerned, also incurred considerable risk of distributing any citrus diseases which occurred on the trees from which the leaves were taken. The use of citrus leaves in this manner in sections where citrus canker occurred was seen to be particularly dangerous. It was, therefore, highly desirable that citrus growers be afforded a source of supply for this fungus which was safe from contamination by citrus canker, scaly bark, and other diseases.

Prof. H. S. Fawcet of the Florida Experiment Station had, during the period from 1907 to 1911, devised a method of growing this fungus in pure cultures on a small scale, using pieces of sterilized sweet potato in wide-mouthed bottles. During the winter of 1915-16 the entomological laboratory was equipped with a sterilizer and the necessary atomizers, glassware, etc., for producing this fungus. It was planned to produce a sufficient number of cultures so that all fruit growers who desired could secure them and the work was undertaken on a large scale. From January to April, 1916, 276 cultures were prepared and of this number 147 or 53 per cent produced spores and developed into proper condition for use in the citrus groves. These were distributed to growers requesting them, at the proper time, a nominal charge of 50 cents per culture being made to cover the actual cost of material used in preparation of each culture. As this was the first attempt ever made to produce this fungus in commercial quantities, some difficulties were encountered in securing proper fruiting or production of spores. However, the securing of 53 per cent of fruited cultures from the total number inoculated appears to have been as great as could have been expected in the absence of previous experience on a large scale.

During the period from May 1 to August 31, 1916, 1,820 cultures were inoculated. Of this number only 211 produced spores and were suitable for use in the field. It was found that during the warm weather the fungus did not develop as well as during the cooler winter months, and after some experiment it was found that by keeping the developing cultures in an ice-box or placing them under buildings where the temperature was lower, fruiting of the fungus was facilitated. There were accordingly distributed by the Entomological Department up to August 31, 1916, a total of 358 cultures which were used by the citrus growers receiving them. As one culture is sufficient to inoculate the whitefly in one acre of citrus trees, the growers were enabled by the use of this material to spray at least a corresponding number of acres. Only a limited number of the growers receiving this material reported upon its use, but out of those which reported, over 50 per cent reported excellent results.

The value of this fungus for the control of the whitefly has been shown to be very great. The use of pure cultures by the growers is not accompanied by the risk of introducing other insects or diseases into their groves and the cost at which the material can be prepared is merely nominal. It was impossible, with the amount of material which the Department was able to produce with its limited resources, to anywhere nearly supply the demand of the citrus growers for this material. Plans are being made to produce it upon a much larger scale during the coming year in the hope that sufficient cultures can be furnished for general use in all sections of the State where the whitefly is known to occur.

AUSTRALIAN LADY-BIRD BEETLES

The Australian lady-bird beetle, or Vedalia, has been found fully as efficient in controlling the cottony cushion-scale in Florida as in California and other States where it has been employed for this purpose. The control of this scale-insect, brought about by the lady-bird beetle, is practically complete. In fact, the lady-bird beetle destroys the scale so thoroughly that the resulting scarcity of the latter results in a marked reduction or disappearance of the beetles because their food supply is exhausted. This, in turn, is usually followed by an increase of cottony cushion-scale. For this reason it becomes necessary to "re-introduce" the lady-bird beetle into cottony cushion-scale areas from time to time. Attempts have been made by the Entomological Department to raise the lady-bird beetles in captivity in large quantities so that a supply would always be available. These experiments were not successful but it was found possible to keep living lady-bird beetles in cold storage for a considerable time and it was also found that supplies of cottony cushion-scale, on which young Vedalia could be raised to maturity, could also be kept in cold storage for a considerable time.

In addition to the lady-bird beetles raised in the Department, others were collected in different sections of the State under a co-operative arrangement with the Nursery Inspection Department, so that it has been possible, with few exceptions, to promptly meet the requests of the growers in the cottony cushion-scale areas. The fact that private parties have at various times sold these lady-bird beetles at a price as high as $1.00 each shows the value which is attached to them by the growers. It has been the practice of the Entomological Department to charge for colonies of these beetles only the estimated actual cost of rearing them or of collecting them in different sections of the State and a uniform price of $1.00 for a colony of ten beetles has been charged. Charging a nominal sum covering the cost of furnishing these insects insures the supply being distributed only to those growers who are actually in need of them.

CAMPHOR-THRIPS

In certain sections of the State camphor trees have been subject for some years past to a severe infection which not only marred their appearance but in many cases killed the trees. Through investigations made by Prof. J. R. Watson, Entomologist of the Florida Experiment Station, it was found that this infection was due to a minute insect described by him as the camphor-thrips. The appearance of this pest in several nurseries where camphor trees were grown made it advisable for the Entomological Department of the Plant Board to determine, if possible, whether any treatment could be applied to the infected trees whereby they could be completely freed from the insect and the resulting infection. During March, 1916, 300 infested camphor trees were secured, planted in separate lots on the University farm at Gainesville and treated with various insecticides. At the time of writing this report, August 31, 1916, it is not considered that sufficient time has elapsed for safe conclusions to be drawn as to the effectiveness of these various treatments. However, one of the treatments, consisting of a two per cent oil emulsion applied to the infested trees after they were severely cut back, gives promise of being both an efficient and practical method for treating infested nursery trees prior to shipment.

INCIDENTAL WORK

The incidental work of the Entomologist and his assistant consists of answering numerous inquiries from farmers and fruit growers regarding injurious insects, the compilation of special information required by other Departments of the Plant Board concerning injurious insects and their habits, the preparation of special reports on insects both in Florida and in other countries for the information of the Plant Board members and the Plant Commissioner, and the preservation of specimens for future reference and information. Careful records are also kept as to the distribution of injurious insects in the State, as this information has an important bearing upon the quarantine measures adopted from time to time by the Board.

During the fiscal year which ended April 30, 1916, the Entomologist delivered addresses on entomological subjects before ten public meetings, and during the period from May 1 to August 31, 1916, before seven meetings.

In co-operation with the College of Agriculture of the University, the Entomologist has constructed a substantial fumigating box which is used jointly for experimental purposes and for fumigating infested material which requires such treatment before it can be safely delivered to Florida customers.

The Entomologist has also conducted experiments with a combination spray of Bordeaux mixture and linseed oil which gives promise of being a preparation which will combine both the qualities of Bordeaux mixture and of a contact insecticide and which will, at the same time, adhere to foliage and bark for long periods of time. Further experiments with this and related spraying preparations will be continued.

DEPARTMENT OF PLANT PATHOLOGY

April 30, 1915, to April 30, 1916

While the object of this Department is to make such investigations as will facilitate the control or eradication of various diseases of fruit and crops, the critical condition brought about by the occurrence of citrus canker demanded that all efforts be concentrated on a study of this disease for the time being.

At its meeting on July 12, 1915, the Board elected Dr. R. A. Jehle, of Santiago de las Vegas, Cuba, as Assistant Plant Pathologist. Dr. Jehle was assigned to duty in Dade County and commenced his work on August 5, 1915.

As the laboratory building at Redland was then still in course of construction by the South Dade Fruit Growers' and Truckers' Association, Dr. Jehle took up studies of citrus canker under field conditions, working in co-operation with the inspection forces. Careful investigation was made of the agencies by which citrus canker is disseminated as well as of the susceptibility to the disease of different citrus host plants.

Upon completion of the laboratory building every effort was made to equip the laboratory as quickly as possible. On account of many needed supplies being of exclusive European manufacture much delay was experienced in securing them. A water-supply plant and gas plant were also installed, and a doubly screened, storm-proof cage constructed in which citrus canker could be safely studied on its host plants, namely, growing citrus plants. An instrument for registering the temperature and humidity within the cage was installed, as were also instruments for keeping accurate record of weather conditions throughout the year.

The laboratory was formally opened on November 27, 1915, even though all necessary equipment had not at that time been installed.

It was necessary, first of all, to develop methods of preparing cultural media upon which the organism* causing citrus canker could be grown and studied, as well as to perfect methods of inoculation, record-keeping, etc.

Among the first experiments undertaken were those in which ripe citrus fruits, which had been picked, were inoculated with citrus canker bacteria. In no case did such fruit develop canker lesions, though grapefruit seedlings inoculated from the same cultures developed the lesions in abundance. This result but confirmed observations previously made in the field to the effect that mature picked fruit would not develop visible canker as the result of contamination at the time of picking. Innumerable cases of canker-infected fruit* have been found on canker-infected trees but in such instances the lesions developed while the fruit was immature and still attached to the tree. These results do not indicate, however, that citrus fruits do not serve as mechanical carriers of the organism or that fruit from canker-infected properties can safely be marketed in citrus-growing sections.

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*Bacterium citri ("Pseudomonas citri") Hasse.

During this period experiments were commenced to determine the effect of various disinfectants upon the canker organism. Investigations were also begun with a view to determining whether any remedy for citrus canker could be devised. Practically all of the commonly used fungicides and disinfectants have been investigated in this connection. However, it was found that even substances which would kill the canker organism upon coming in contact with it would not serve as remedies for they could not reach or affect those bacteria which were already within the plant tissue. In like manner, substances sufficiently caustic or penetrating to reach bacteria in the tissues were as destructive to the trees as the citrus canker itself.

Not the least in importance of the work done at the laboratory has been the identification of numerous specimens and verifying, by laboratory methods, the diagnoses of infected trees by the field inspection forces. Numerous specimens of citrus canker, on various citrus host plants, have been preserved, after suitable disinfection, both as records of the infections themselves and for future study and reference.

May 1, 1916, to November 30, 1916

During this period the investigations already under way were continued and additional lines of investigation inaugurated.

Observations of the disease on different host plants showed them to be susceptible to the disease in the following order: pomelo (grapefruit), ponderosa lemon, key lime, Citrus trifoliata, sour orange, tangelo, sweet orange, tangerine, king orange, mandarin-lime and kumquat. That is, the pomelo was found most readily infected and subject to the greatest damage, while the kumquat was least susceptible.

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*In some instances such fruit has been so badly infected that it was shriveled and virtually mummified.

Tests of disinfectants showed that the canker bacteria are killed by direct exposure to corrosive sublimate solution, at a strength of 1 part to 1,000 parts of water, for a period of one minute. As this disinfectant had been used for some months previously in connection with the field work for disinfecting inspection suits, implements, etc., it was gratifying to learn that careful laboratory experiments confirmed previous opinions as to its efficiency for these purposes. Five per cent carbolic acid and a two per cent formaldehyde solution were also found to be efficient destroyers of the canker bacteria, as was also formaldehyde gas, produced by generating the gas from 10 cubic centimeters of formaldehyde and 5 grams of potassium permanganate to each 13 cubic feet of space in the fumigating chamber. Numerous other disinfectants were tested, the majority of them proving ineffective.

In studying the ecology of the disease it was found that it was most severe and the incubation period shortest during warm, moist weather. The disease was also found to develop most rapidly on citrus trees in a vigorous growing condition.*

All supposed canker " cures " submitted by parties not affiliated with the canker eradication work have been carefully investigated. Those which have given even the slightest promise of possible usefulness have been tested. In no case has any supposed remedy submitted proved to possess any efficacy.

Experiments are under way in developing methods of satisfactorily disinfecting non-citrus trees and plants grown in canker-infected citrus properties. On account of the danger of soil infection such plants may serve as mechanical carriers of canker bacteria. The satisfactory conclusion of these experiments will provide the means, in many instances at least, by which non-citrus trees and plants, such as avocado, mango,

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*At first sight it would appear that trees which had been exposed to the infection should be kept in as dormant a condition as possible, cultivation and fertilization refrained from and growth discouraged in every way. However, exactly the reverse is true. If a tree **has** become infected with the organisms they apparently do not die, no matter how long the tree is kept in a semi-dormant or neglected condition, but persist until active growth does occur, when the canker lesions become visible. It is therefore desirable that the infection be "brought out" on infected trees as quickly as possible, in order that the infected ones may be detected so that they will no longer constitute sources of infection for other trees. The best results in the eradication work have been secured by giving the best of care and attention to trees suspicioned of being infected, thus developing, and removing, all infections present in the shortest time possible. So clearly is this recognized in localities where canker has occurred that neglected or abandoned citrus groves are looked upon as public menaces.

peach, pecan, etc., can be removed from canker-infected properties and safely used for planting purposes elsewhere.

The Assistant Plant Pathologist has prepared an article on "Means of Identifying Citrus Canker," describing the appearance of the disease and illustrated with both colored and half-tone plates. This article was published in the "Quarterly Bulletin" of the Plant Board, Vol. 1, No. 1.

The demand from citrus growers for complete and exhaustive information regarding citrus canker has been insistent. Dr. Jehle has accordingly prepared an extended treatise on the history, economic importance and etiology of the disease, the cultural characteristics and pathogenesis of the organism causing it, the effects of various disinfectants and the bearing of this information upon the practical work of eradicating the disease. Space forbids the presentation of this article here but it is planned to publish it in the Quarterly Bulletin of the Board at an early date.*

CO-OPERATION WITH FOREIGN GOVERNMENTS

The proximity to Florida of many sub-tropical islands and countries in which dangerous insects and diseases are likely to occur renders it of the utmost importance that the Plant Board should be fully informed regarding such pests as may be introduced therefrom into Florida through commercial channels.

THE BAHAMAS

Persistent reports to the effect that citrus canker occurred in The Bahamas, coupled with the fact that there is a constant heavy travel and considerable commerce between The Bahamas and Miami and Jacksonville, resulted in the Plant Board sending Dr. J. H. Montgomery, of its canker eradication staff, to Nassau in May, 1916, for the purpose of investigating these rumors. Dr. Montgomery was most cordially received by His Excellency, Sir William Allardyce, Governor of The Bahamas, and also by the Acting Colonial Secretary, Honorable T. E. D. Brace, and every facility placed at his command for investigating conditions in the islands.

Doctor Montgomery's investigations did not reveal the presence of citrus canker in The Bahamas but did bring to light the existence there of a little-known but very destructive insect known as the " spiny citrus white fly ". Many citrus trees had died from its attacks, while many others had been cut down by their owners after ineffectual efforts to control the pest. The insect was also found to attack avocado, mango and other trees.

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*Published in The Quarterly Bulletin, Vol. I, No. 2.—Editor.

As a result of this information the Plant Board was enabled to take prompt measures in keeping this pest out of Florida. It has since been learned that this pest occurs in Jamaica as well as in a very limited area in Cuba. There can be little doubt but what this insect, if once established in Florida, would rival citrus canker in destructiveness, but unlike the latter disease would also attack a large variety of other trees and plants.

Subsequent to Dr. Montgomery's visit to The Bahamas the Colonial Legislature passed a Plant Protection Act, not unlike the Florida Plant Act of 1915, and a systematic attempt is now being made there to control the spiny citrus white fly.

CUBA

As early as 1914, those interested in canker eradication in Florida established cordial relations with the Cuba Experiment Station, furnishing the Plant Pathologist of the Station, Prof. John R. Johnston, with information regarding citrus canker and receiving in return information as to conditions in Cuba.

On July 3, 1916, the President of Cuba signed a decree creating the " Comision de Sanidad Vegetal ", or Commission of Plant Sanitation. Under the direction of this Commission active measures have been taken to repress the spiny citrus white fly in the limited area in which it occurs and eradication of the pest from Cuba is anticipated.

A survey of the citrus areas of Cuba has also been made with the gratifying result that no citrus canker has been found.

The control or repression of dangerous insects and diseases in adjacent countries affords a large degree of protection to Florida by reducing the chances for these pests gaining a foothold here. In like manner the Plant Board of Florida cannot obtain an adequate knowledge of conditions in nearby countries save through co-operation with the officials in charge of corresponding work therein. It is hoped that the cordial co-operative relations already established with the government officials of Cuba and The Bahamas can shortly be extended to other governments in the West Indies and Central America.

ENDORSEMENTS OF THE PLANT BOARD'S WORK

The work being conducted by the Plant Board has been the subject of many favorable comments in the press of the State as well as in publications of other States, particularly California.

Hundreds of letters commending the Board on its activity in not only waging an active eradication campaign against canker, but against many other diseases and insects, are on file in the Plant Commissioner's office at Gainesville.

Resolutions of similar tenor have been adopted by many fruit growers' associations and meetings of various kinds. Special mention should be made of resolutions adopted by the Florida State Horticultural Society in April, 1916, and by a mass meeting of citrus growers at Gainesville in October, 1916. These resolutions were as follows:

RESOLUTIONS ADOPTED BY THE FLORIDA STATE HORTICULTURAL SOCIETY AT ARCADIA, APRIL 26, 1916

The Committee on Resolutions presented the following:

"Mr. Tenny: 'Mr. Chairman, those of us who have been closely associated with the demonstration work under the Plant Act have been impressed with one thing, namely, that the only appropriation carried in the Act itself is not going to be sufficient to carry the demonstration work of the Plant Board as it should be carried in order to properly protect our interests. When the sum of $35,000.00 was suggested and when we went to Tallahassee to ask for that sum we thought it would be ample, but the development of the work has been so rapid and the fields of endeavor have broadened so widely that the sum is really not over fifty per cent of what we need to carry out our ordinary work that comes under the scope of the Plant Act. This, you understand, is entirely aside from the citrus canker work that we hope is more or less temporary, and is an annual appropriation that will go on indefinitely. Therefore, in order to meet the situation, we present the following resolution:'

"WHEREAS, the present annual State appropriation of $35,000.00 will not furnish sufficient funds to do this, therefore, be it

"RESOLVED, that the Florida State Horticultural Society, assembled in annual session, recommend to the State Plant Board that in their estimate to be prepared for and presented to the next session of our State Legislature, they increase the amount estimated for the administration of the Plant Act to a sum sufficient to carry out the provisions of this law in a way that will protect the Agricultural and Horticultural interests of the State."

(Resolution seconded and adopted.)

"WHEREAS, the members of the Florida State Horticultural Society are vitally interested in the welfare of the citrus industry, many of them directly, by reason of their grove holdings, and others indirectly, by reason of the importance of the industry in the development and prosperity of Florida, and

"WHEREAS, in the raising of funds for the eradication of citrus canker by public subscription, in the work of securing the enactment by the Florida Legislature of the law creating a State Plant Board and the measure appropriating $125,000.00 for the fight on citrus canker and in the campaign to secure aid from the Federal Government for the further prosecution of the canker eradication work, the members of this society have taken an active and influential part, and

"WHEREAS, it is now certain, that no living man or group of men can accurately estimate the cost of carrying to a final conclusion this citrus canker eradication work or definitely determine the period of its duration and it is exceedingly probable that funds in addition to those now available will be required to complete the conquest of the disease, and

"WHEREAS, The State of Florida not only is required by the interests of her most important single industry to stand behind the fight on citrus canker until it has been entirely won, but also is under a moral obligation to do so in order to justify the Federal Government for the aid it has given and in extending further work as may be asked for, now therefore, be it

"RESOLVED, by the Florida State Horticultural Society in annual convention assembled at Arcadia on April 26th, 1916, that we regard it as incumbent on the next session of the State Legislature (provided citrus canker has not been eradicated) to appropriate such additional sums for citrus canker eradication as in the judgment of the State Plant Board may be necessary and we as individuals pledge ourselves to request from all candidates for members of the House of Representatives and State Senate in our respective counties and districts pledges to support such appropriations."

(Resolution seconded and adopted.)

RESOLUTIONS ADOPTED BY THE MEMBERS OF THE FLORIDA CITRUS SEMINAR AT GAINESVILLE, OCTOBER 18, 1916

"WHEREAS, the present annual State appropriation of $35,000.00 will not furnish sufficient funds to carry out the terms of the Plant Act, therefore, be it

"RESOLVED, that the Mass Meeting of citrus growers in attendance at the Citrus Seminar at Gainesville, assembled in annual session, recommend to the State Plant Board that in its estimate to be prepared for and presented to the next session of our State Legislature, they increase the amount estimated for the administration of the Plant Act to a sum sufficient to carry out the provisions of this law in a way that will fully protect the Agricultural and Horticultural interests of the State.

"WHEREAS, the members in attendance at the Florida Citrus Seminar are vitally interested in the welfare of the citrus industry, many of them directly, by reason of their grove holdings, and others indirectly, by reason of the importance of the industry in the development and prosperity of Florida, and

"WHEREAS, in the raising of funds for the eradication of citrus canker by public subscription, in the work of securing the enactment by the Florida Legislature of the law creating the State Plant Board and the measure appropriating $125,000.00 for the fight on citrus canker and in the campaign to secure aid from the Federal Government for the further prosecution of canker eradication work, the members in attendance at this Mass Meeting have always taken an active part and influential part, and

"WHEREAS, it is now certain that no living man or group of men can accurately estimate the cost of carrying to a successful conclusion this citrus canker eradication work or definitely determine the period of its duration and it is exceedingly probable that funds in addition to those now available will be required to complete the conquest of this disease, and

"WHEREAS, the State of Florida not only is required by the interests of her most important single industry to stand by the fight on citrus canker until it has been entirely won, but is also under moral obligation to do so in order to justify the Federal Government for the aid it has given and in extending further work as may be asked for, now therefore, be it

"RESOLVED, by the Mass Meeting of citrus growers in annual convention assembled at the Citrus Seminar at Gainesville on October 18th, 1916, that we regard it as incumbent on the next session of the State Legislature (provided citrus canker has not been eradicated) to appropriate such additional sums for citrus canker eradication as in the judgment of the State

Plant Board may be necessary, and we as individuals pledge ourselves to request of all members of the House of Representatives and State Senate in our respective Counties and Districts pledges to support such appropriations."

THE QUARTERLY BULLETIN

As a means of placing in the hands of the farmers and fruit growers of the State information regarding various insects and diseases against which the Plant Board is directing measures of control or eradication, as well as for making available to the public the results of investigations being carried on, the Board authorized the publication of " The Quarterly Bulletin of the State Plant Board of Florida ".

The first issue, Volume 1, No. 1, was published in October, 1916, and was devoted mainly to descriptions of citrus canker. A copy of this issue will be found in the appendix to this report. Application for entry of The Bulletin as second-class mail matter at the post office at Gainesville has been made and approved.

Inasmuch as the Plant Board cannot avail itself of any franking privilege for the distribution of its publications by mail the use of a regular publication, mailable at the second class rate of postage, appears to be the most practical and economical way of placing information in the hands of growers and other citizens directly interested in the Board's work.

EMPLOYEES

Owing to the magnitude of the tasks in which it is engaged, coupled with the active co-operation with the Bureau of Plant Industry in the eradication of citrus canker and with the Federal Horticultural Board in the inspection of plant importations, the Board necessarily has a large number of employees. Taking into consideration the fact that trained employees for such work as the Board is doing are not regularly available, in the sense that engineers, bookkeepers, chemists, physicians and the like are available for meeting emergencies, and the fact that the Board has itself had to train the great majority of its employees for their particular duties, it is remarkable that so efficient an organization has been gotten together in so short a time.

Space forbids a presentation of data showing the periods during which different employees have been engaged and as this information is available in the Plant Commissioner's office at

Gainesville we give here the names of only such employees as were on duty at the close of the fiscal year.

EMPLOYEES WHOSE APPOINTMENTS WERE EFFECTIVE ON APRIL 30, 1916

Secretary's Office

Kellum, J. G., *Secretary*
Burch, F. A., *Assistant*

Plant Commissioner's Office

Newell, Wilmon, *Plant Commissioner*
Goodwin, J. C., *Chief Clerk*
Simmons, Mrs. L. A., *Stenographer*
Cornwell, Miss Madge E., *Stenographer*
Lampkin, Miss Isabel, *Stenographer*
Mabee, Miss Mildred, *Office Assistant*
Lloyd, Henry (col.), *Janitor*

Department of Citrus Canker Eradication*

(Plant Commissioner in Charge)
Stirling, Frank, *General Inspector*

DISTRICT INSPECTORS

Clark, Virgil I.
Daniel, Leon A.
Gist, J. V.
Hainlin, Neal E.
Heck, Joy
Henry, A. M.
Horton, H. A.
Miller, J. A.
Nieland, F. C.
Schlobig, John
Swanson, A. L.
Wilson, G. H.

ASSISTANT DISTRICT INSPECTORS

Bollinger, Harry D.
Campbell, Matthew G.
Goldberg, Edward Robert
Fletcher, J. M.

GROVE SUPERVISORS

Bragdon, Kenneth E.
Montgomery, J. H.
Chandler, A. L.
Grennell, Virgil M.
Thompson, Alpheus A.

FOREMEN OF INSPECTORS

Adams, Arthur
Adams, Benj. Franklin
Albrecht, Chas. J.
Ayer, Aubrey E.
Barcus, George D.
Bateman, Raymond G.
Burden, G. F.
Carter, Howard G.
Cash, Richard P.
Chandler, Luther L.
Cox, Charles A.
Crum, Lemil Clarence
Dillingham, H. J.
Dixon, C. D.
Douglass, Elmer E.
Eikenberry, H. D.
Flowers, B. L.
Gaston, B. O.
Gibson, Pearl B.
Gossman, Harvey L.
Green, Joseph T.
Higley, Albert W.
Hobson, Robt. Leonard
Hoenshel, Paul M.
Holcomb, James M.
Holland, James S.
Ingram, John W.
Ingram, Otis D.
Kelly, Emory L.
Kiner, James Otis
Laing, James David
Liles, Ed.
Little, F. L.
Mahan, William D.
Matthews, Stanley F.
McClanahan, Samuel L.
Mears, John M.
Potter, Edwd. Raymond
Raab, Albert G.
Rahn, W. J.
Reynolds, Roscoe
Richmond, Leon C.
Rowe, William L.
Schumacher, Henry E.
Sealey, John
Sheffield, Chas. P.
Smith, Cleve F.
Stone, O. T.
Strain, John G.
Tedder, Geo. E.
Wait, Stephen B.
Witt, Henry S.
Woodberry, Edw. R.

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*As the work of this Department is conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, salaries of the employees, with the exception of the Plant Commissioner, are defrayed out of either State or Government funds, or both, as circumstances may require.

INSPECTORS

Albrecht, Alfred C.
Baker, Willie O.
Bass, Clarence A.
Bass, Milledge M.
Black, Alvin L.
Blackburn, Grover C.
Bosse, Rufus F.
Boyett, Marshal M.
Browne, Clarence E.
Bynum, Eli K.
Chandler, Stewart C.
Chubb, Leland M.
Clark, Arthur J.
Clinger, John A.
Conner, Daniel S.
Crapo, David
Crum, Westley A.
Culley, Percy Edward
Curry, W. R.
Cutts, William H.
Daniel, Basil E.
Davis, Robert H.
Dixon, Albert LeRue
Dubbin, James McC.
Dunaway, Wilbur E.
Eberhardt, Walter F.
Edson, Perry M.
Eiland, John
Fish, Robert E.
Fitch, Samuel H.
Flora, Roy
Forbes, Walter R. T.
Ford, Arthur E.
Frierson, Hill H.
Fry, Benjamin B.
Fuchs, Fritz
Gaines, Geo. B. F.
Gearing, Jesse
Gench, Carl
Glegg, George
Graves, Thomas L.
Gwynn, Eddie L.
Hall, James E. B.
Harter, W. W.
Hatfield, Jeptha C.
Haywood, Frank E.
Hearn, Bryant Eugene
Henderson, Francis M.
Henderson, William H.
Hinson, Paul F.
Hoffman, Paul Frank
Holland, Chas. Hubert
Holland, Joseph W.
Hooker, Alphonse S.
Houston, Mills R.
Hunt, Chas. M.
Ingraham, Charles F.
Ishmael, Joseph L.
Jenness, Walter E.
Johnson, August P.
Kelley, Hugh L.
Kerr, James
Kinyoun, Gray
Kirkpatrick, Lawrence L.
Knighton, Harvey B.
Lasher, Abraham H.
Lasher, Leslie C.
Lazonby, J. Lionel
Lee, Dock
Lee, Henry C.
Lenz, Friedrich
LeRoy, Merton
Lindner, Ross W.
Linger, Russell B.
Little, Arnaud R.
Little, Leland S.
Lower, William D.
Ludlam, Joseph W.
Mahan, Charles R.
Marsh, Berry L.
McAllister, Alonzo O.
McCullough, James D.
McLendon, Albert S.
McLendon, John A.
Merrill, William H.
Millington, Wm. V.
Mills, Steve T.
Mongle, Thos. M.
Moore, Joseph W.
Moore, Jules B.
Murphy, Noah A.
Nanney, Wm. C.
Niedernhoefer, Wm. F.
Norwood, Jesse A.
Norwood, John N
Nutting, Chas. T
Oliphant, Ross G.
O'Shields, Odom S.
Osteen, Ray J.
Owens, Thomas E.
Parham, Hosmer S.
Park, Bradley
Parker, Frank R.
Pemberton, Redden H.
Peters, Ralph
Putnal, Bonnie W.
Rawls, John C.
Reese, Mitchell A.
Reynolds, David N.
Roberts, Frank Arthur
Roberts, George L.
Roberts, Henry L.
Roberts, Leon F.
Roberts, Samuel F.
Robinson, Tom
Robinson, Vernon K.
Rodgers, Wm. B.
Ross, George N.
Ross, James Brown
Sadler, Ralph T.
Simmons, James R.
Simonds, Jay
Smith, Lonnie S.
Snell, Robert L.
Stephens, Charlie S.
Stephens, William L.
Stevens, R. C.
Stevenson, Asbary C.
Stokes, Clifford
Strong, C. E.
Sturrup, Eric G.
Swartsel, Howard B.
Thomas, William H.
Tobias, Benj. B.
Ulmer, Julius E.
Vaughan, James D.
Wade, George W.
Walker, George Samuel
Walton, William Karl
Wartmann, Henry A.
Wells, Benjamin B.
Wever, Ellison Capers
Wiley, Talmage M.
Wilson, James H.
Wilson, Joseph H.
Wood, Clarence O.
Yetter, Morris D.

Department of Nursery Inspection

F. M. O'Byrne, *Nursery Inspector*, in Charge
Harn, S. P., *Assistant Nursery Inspector**
Zeluff, U. C., *Assistant Nursery Inspector*
Grimes, D. W., *Assistant Nursery Inspector*
Chaffin, J., *Assistant Nursery Inspector*
Bibby, F. F., *Assistant Nursery Inspector*
DaCosta, Miss Mary W., *Stenographer*
McIlvaine, Miss Lucretia, *Stenographer*

Packing-House Inspectors**

Alexander, G. T.
Baskin, J. D.
Bearss, W. O.
Campbell, W. P.
Childs, J. E.
Davis, L. L.
Francis, H. H.
Hinderliter, M. L.
Kime, C. D.
Lee, W. E.
LeGreid, W. C.
McCraney, D.
Meares, A. L.
Meares, George W.
Miller, H. A.
Morrow, A. G.
Stoltz, F. W.
Williams, Boyce

Department of Entomology

Dr. E. W. Berger, *Entomologist*, in Charge
Mason, A. C., *Assistant Entomologist*
Evans, Miss Ella M., *Stenographer*

Department of Port and Railway Inspection

(Plant Commissioner in Charge)

Hull, W. N., *Deputy Port and Railway Inspector**
Brown, A. C., *Deputy Port and Railway Inspector*
Gehry, Emil L., *Deputy Port and Railway Inspector*
Merrill, Geo. B., *Deputy Port and Railway Inspector*
Brown, Luther, *Deputy Port and Railway Inspector*

Department of Plant Pathology

(Plant Commissioner in Charge)

Jehle, Dr. R. A., *Assistant Plant Pathologist*

Employees Whose Appointments Were Effective on November 30, 1916

Secretary's Office

Kellum, J. G., *Secretary*
Burch, F. A., *Assistant*

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*As the inspection of citrus nurseries constitutes an important part in the eradication of citrus canker, salaries and expenses of assistant nursery inspectors assigned to the inspection of citrus nurseries are defrayed out of either Plant Board or Bureau of Plant Industry funds, or both, as circumstances may require.

** "Packing-house inspectors" are employed to supervise the fumigating, dipping, scrubbing or other precautionary treatments prescribed for nursery stock packed by certain nurseries, such as those occurring in cottony cushion-scale areas, etc., and are paid only for time actually employed. The wages of the packing-house inspectors are charged to the nurseries in which their work is performed. The Plant Board incurs no expense for their services.

*Deputy Port and Railway Inspectors of the State Plant Board are also Collaborators of the Federal Horticultural Board, U. S. Department of Agriculture, but as such receive only a nominal salary of $1.00 per month each. No other expense in connection with the port and railway inspection work in Florida is defrayed by the Federal Horticultural Board.

Plant Commissioner's Office

Newell, Wilmon, *Plant Commissioner*
Goodwin, J. C., *Chief Clerk*
Simmons, Mrs. L. A., *Stenographer*
Cornwell, Miss Madge E., *Stenographer*
Lampkin, Miss Isabel, *Stenographer*
Carlisle, Mrs. Kathleen R., *Stenographer*
Colson, Mrs. K. D., *Stenographer*
Wallyn, Miss Evlyn, *Stenographer*
Mabee, Miss Mildred, *Office Assistant*
Lloyd, Henry (col.), *Janitor*

Department of Citrus Canker Eradication

(Plant Commissioner in Charge)
Stirling, Frank, *General Inspector*

DISTRICT INSPECTORS

Campbell, Matthew G.
Clark, Virgil I.
Daniel, Leon A.
Gist, J. V.
Hainlin, Neal E.
Heck, Joy
Horton, H. A.
Mears, John M.
Miller, J. A.
Nieland, F. C.
Schlobig, John
Smith, Cleve F.
Swanson, A. L.
Wilson, G. H.

ASSISTANT DISTRICT INSPECTORS

Albrecht, Charles J.
Bass, Milledge M.
Bollinger, Harry D.
Carter, Howard G.
Fletcher, J. M.
Goldberg, Edward Robt.
Hoenshel, Paul M.
Potter, Edwd. Raymond
Tedder, George E.
Wartmann, Henry A.

GROVE SUPERVISORS

Bragdon, Kenneth E.
Grennell, Virgil M.
Montgomery, J. H.
Thompson, Alpheus A.

FOREMEN OF INSPECTORS

Adams, Arthur
Adams, Benj. Franklin
Artis, Harvey C.
Baker, Thos. J.
Barber, Bascom D.
Barcus, George D.
Bateman, Raymond G.
Bearden, Cleveland C.
Browne, Clarence E.
Burden, G. F.
Cary, Chas. L.
Cash, Richard P.
Chandler, Luther L.
Cox, Charles A.
Crum, Lemil Clarence
Culley, Percy Edward
Dillingham, H. J.
Dixon, C. D.
Douglass, Elmer E.
Eikenberry, H. D.
Eiland, John
Flowers, B. L.
Ford, Arthur E.
Fuchs, Fritz
Gaines, Geo. B. F.
Gaston, B. O.
Gibson, Pearl B.
Gossman, Harvey L.
Graham, Erwin M.
Green, Joseph T.
Gwynn, Eddie L.
Harter, W. W.
Haywood, Frank E.
Henderson, Rufus C.
Henderson, William H.
Hobson, Robt. Leonard
Holcomb, James M.
Horton, Edward S.
Ingram, John W.
Ingram, Otis D.
Johnson, August P.
Kelly, Emory L.
Kerr, James
Laing, James David
Liles, Ed.
Lindner, Ross W.
Lower, William D.
Ludlam, Joseph W.
Mahan, William D.
McClanahan, Howard S.
McClanahan, Samuel L.
Mendel, James C.
Millington, Wm. V.
Nutting, Chas. T.
O'Neal, James R.
O'Shields, Odom S.
Parker, Frank R.
Raab, Albert G.
Rahn, Wm. J.
Reynolds, David N.
Reynolds, Roscoe
Richmond, Leon C.
Rogers, Frazier
Schumacher, Henry E.
Scott, William J.
Sheffield, Chas. P.
Sloan, Geo. D.
Stephens, William L.
Stone, O. T.
Strain, John G.
Swartsel, Howard B.
Thomas, William H.
Thompson, Troy
Vaughn, Molloy C.
Wade, George W.
Wait, Stephen B.
Warner, L. Russell
Williford, Talmage Y.
Witt, Henry S.

INSPECTORS

Albrecht, Alfred C.
Alexander, David H.
Alexander, Guy T.
Baillie, Wm. J., Jr.
Baker, Byrd O.
Baker, George H.
Baker, J. Otis
Baker, L. J.
Baker, Willie O.
Ball, Joseph H.
Barnett, Harry B.
Bass, Clarence A.
Beaty, Alwyn L.
Benedict, William L.
Beville, Ulmont U.
Black, Alvin L.
Blackburn, Grover C.
Bosse, Rufus F.
Boyett, Marshal M.
Bradford, Horace
Branan, James Ruben
Brown, Charles M.
Brown, James B.
Brown, Merle R.
Brown, Ollie D.
Buchanan, Rex
Buff, William D.
Butts, John L.
Calcote, William H.
Camp, Paul Z.
Carpenter, Stanley D.
Cash, R. A.
Cellon, F. M.
Chamberlin, Harry T.
Church, Harry W.
Clark, Arthur J.
Clinger, John A.
Conner, Daniel S.
Craft, Fred L.
Crum, Westley A.
Curry, W. R.
Cutts, William H.
Daniel, Basil E.
Daughtrey, J. A., Jr.
Davis, Robert H.
Dickey, Edward K.
Dickson, Albert M.
Dobbin, James McC.
Donaldson, Wilson T.
Dukes, James R.
Dukes, Redding A.
Dunaway, Wilbur E.
Dyson, Zeblon V.
Eberhardt, Walter F.
Ellis, Thos. R.
Fish, Robert E.
Fitch, Samuel H.
Fogg, Harry W.
Forbes, Walter R. T.
Freeman, Jesse W.
Frierson, Hill H.
Frierson, Ed.
Fry, Benjamin B.
Fuller, Richard M.
Garcia, John R.
Gench, Carl
Grace, Don H.
Graves, Thomas L.
Gray, Charles F.
Hall, Clayton E.
Hall, James E. B.
Hammell, David L.
Hampson, Charles M.
Hansen, Hans W. A.
Harkins, D. L.
Harrison, Cyrus J.
Henderson, Francis M.
Henderson, J. Harvey
Hoffman, Paul Frank
Holland, Edward Alton
Holland, Joseph W.
Holton, John C.
Hood, Richard V.
Hooker, Alphonse S.
Howell, John F.
Hutchinson, D. O., Jr.
Ingraham, Charles F.
Irwin, Harry M.
Ishmael, Joseph L.
Jackson, Henry C.
Jackson, James
Janes, George
Jenness, Walter E.
Keller, P. C.
Kersey, Walter L.
Knight, Robert L.
Kinyoun, Gray
Lahrman, Walter O.
Lamb, Kirkland S.
Lasher, Abraham H.
Lasher, Leslie C.
Lawley, Harley H.
Lazonby, J. Lionel
Lee, Dock
Lee, Henry C.
Lee, Lewis M.
Lee, Russell E.
Lenz, Friedrich
LeRoy, Merton
Levis, Norris K.
Light, L. S., Jr.
Lindley, Kingston H.
Little, Arnaud R.
Mahan, Charles R.
Maloney, Clarence B.
Marsh, Berry L.
Marsh, James F.
Marshall, Galen G.
Martin, Clarence W.
McAllister, Alonzo O.
McCullough, James D.
McKay, Haden M.
McLendon, John A.
McMullen, Henry L.
Melendy, B. E.
Melton, Wilburn P.
Merrill, William H.
Miller, Herbert L.
Moore, John L.
Moore, Joseph W.
Moore, Jules B.
Morgan, James Raiford
Mowry, Harold
Neal, Cecil G.
Niedernhoefer, Wm. F.
Nixon, Roy R.
Norwood, Jesse A.
Noxtine, H. A.
Oakley, Archie R.
Oliphant, Ross G.
Parham, Harry C
Park, Bradley
Pemberton, Henry F.
Pemberton, Redden H.
Pinelli, Joe
Poos, Fred W., Jr.
Potter, Roscoe D.
Pryor, T. J.
Putnal, Bonnie W.
Rawls, Axon Badger
Reese, Mitchell A.
Roberts, Frank Arthur
Roberts, Geo. L.
Roberts, Samuel F.
Robertson, Paul F.
Robinson, Tom
Robinson, Vernon K.
Rodgers, William B.
Ross, George N.
Ross, James Brown
Royal, John W.
Rudesill, Dick
Salls, Kenneth T.
Scudder, Hamilton F.
Sealey, John
Seeds, Harvey W.
Seitz, Harry G.
Shelton, J. L.
Sherman, Charles D.
Sherouse, Dave T.
Shriner, Ike M.
Simmons, James R.
Simonds, Jay
Smith, Clyde
Smith, Herman D.
Smith, Joseph G.
Smith, Lawrence O.
Smith, Lonnie S.
Spiller, William A.
Steil, Fred H.
Stephens, Charlie S.
Stevens, R. C.
Stevenson, Asbary C.

INSPECTORS (Continued)

Stevenson, Elbert M.
Stevenson, George A.
Stevenson, Richard D.
Stokes, Clifford
Strong, C. E.
Swann, Porter R.
Taylor, Jesse F.
Thomas, Paul
Thompson, Roy
Thomson, James
Tryon, Harry D.
Ulmer, Julius E.
Ulmer, Robert L.
Vaughan, James D.
Vetter, Paul
Vincent, Clarence A.
Walker, George Samuel
Walker, Shirley B.
Wells, Benjamin B.
Wells, Paul L.
Wever, Ellison Capers
Whidden, Marion T.
Whitehurst, Andrew A.
Whitehurst, Linton L.
Whittington, C. E.
Wilder, H. S.
Wilson, James H.
Wilson, Joseph H.
Wood, Clarence O.
Woodruff, Seth L.

Department of Nursery Inspection

F. M. O'Byrne, *Nursery Inspector*, in Charge
Harn, S. P., *Assistant Nursery Inspector*
Zeluff, U. C., *Assistant Nursery Inspector*
Chandler, Stewart C., *Assistant Nursery Inspector*
Bibby, F. F., *Assistant Nursery Inspector*
Nanney, W. C., *Assistant Nursery Inspector*
Roberts, Leon F., *Assistant Nursery Inspector*
Bynum, Eli K., *Assistant Nursery Inspector*
Wilson, C. E., *Assistant Nursery Inspector*
Kirkpatrick, L. L., *Assistant Nursery Inspector*
Hunt, Chas. M., *Assistant Nursery Inspector*
Carothers, A. B., *Assistant Nursery Inspector*
Linger, R. B., *Assistant Nursery Inspector*
DaCosta, Miss Mary W., *Stenographer*
McIlvaine, Miss Lucretia, *Stenographer*

Packing-House Inspectors

Aligood, C. E.
Bearss, W. O.
Block, W. C.
Bruyiere, J.
Campbell, W. P.
Conrad, Chas. A.
DeLanoy, S. S.
Dougherty, Lynn
English, B. S.
Francis, H. H.
Gantt, J. E.
Jenner, J. T.
Keller, Wm.
Kime, C. D.
Lee, W. E.
Luce, D. H.
McCollom, J. A.
McCraney, D.
Millen, S. E.
Miller, H. A.
Oesterle, Chas.
Parker, P. C.
Pylant, S. L.
Rogers, O. H.
Roper, B. H.
Sadler, F. W.
Scorgie, L. A.
Smith, L. W.
Stewart, J. L.
Stoltz, F. W.
Summerall, Perry
Tate, L. Z.
Townsend, L. N.
Tullbery, C. C.
Williams, Boyce
Wright, W. W.

Department of Entomology

Dr. E. W. Berger, *Entomologist*, in Charge
Mason, A. C., *Assistant Entomologist*
Evans, Miss Ella M., *Stenographer*

Department of Port and Railway Inspection

(Plant Commissioner in Charge)

Hull, W. N., *Deputy Port and Railway Inspector*
Brown, A. C., *Deputy Port and Railway Inspector*
Gehry, Emil L., *Deputy Port and Railway Inspector*
Merrill, George B., *Deputy Port and Railway Inspector*
Brown, Luther, *Deputy Port and Railway Inspector*
Grimes, D. W., *Deputy Port and Railway Inspector*
Staples, I., *Deputy Inspector*
Mitchell, Joseph, *Deputy Inspector*

Department of Plant Pathology

(Plant Commissioner in Charge)

Jehle, Dr. R. A., *Assistant Plant Pathologist*
McKay, Haden M., *Temporary Assistant*

FINANCIAL REPORT

The following report on the finances of the Board is submitted by Mr. J. G. Kellum, Secretary:

" TALLAHASSEE, FLA., Sept. 30, 1916.

State Plant Board.

GENTLEMEN:—I have the honor to submit the following report of the finances of the Board for the period beginning May 1st, 1915, and ending Sept. 30th, 1916.

SUMMARY

Resources

General Appropriation for year ending April 30, 1916	$35,000.00	
General Appropriation for year ending April 30, 1917	35,000.00	
Special Appropriation for the Eradication of Citrus Canker	125,000.00	
Donations and Incidental Collections	5,369.27	
Total		$200,369.27

Expenditures

For Salaries	$116,236.96	
For Office Supplies	7,427.74	
For Traveling Expenses	20,718.60	
For Printing Bulletins, etc.	2,241.24	
For General Supplies	11,662.05	
For Miscellaneous Expenses	2,513.56	
Unexpended part of Appropriation for year ending April 30, 1916	.18	
Total Expenditures		$160,800.33
Balance September 30, 1916		$ 39,568.94 "

ITEMIZED EXPENDITURES

Resources. Special Fund

Appropriation		$125,000.00

Expenditures

For Salaries	$ 88,232.41	
For Office Supplies	323.63	
For Traveling Expenses	14,498.97	
For Printing Bulletins	34.00	
For General Supplies	6,274.81	
For Miscellaneous Expenses	1,684.57	
Total Expenditures		111,048.39*
Balance Unexpended September 30, 1916		$ 13,951.61

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*Does not include expenses incurred during September, 1916, vouchers for which were approved at the October Board meeting.

DONATIONS AND INCIDENTAL COLLECTIONS

Resources

Total Receipts from May 1, 1915, to September 1, 1916		$ 5,369.27

Expenditures

For Salaries	$ 1,645.50	
For Traveling Expenses	75.56	
For Printing	1.95	
For General Supplies	1,530.75	
Total Expenditures to September 30, 1916		3,253.76
Balance on Hand September 30, 1916		$ 2,115.51 "

GENERAL FUND

For Year Ending April 30th, 1916

Resources

Appropriation	$ 35,000.00

Expenditures by Items

For Salaries	$ 18,014.74	
For Office Supplies	6,596.47	
For Traveling Expenses	5,122.07	
For Printing Bulletins	1,527.09	
For General Supplies	3,131.75	
For Miscellaneous Expenses	607.70	
Balance Unexpended for Expenses of Year	.18	
Total		$ 35,000.00 "*

For Year Ending April 30th, 1917

Resources

Appropriation	$ 35,000.00

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*The disbursement of the General Fund during the fiscal year ending April 30, 1916, classified by departments rather than by items, was as follows:

Plant Board, Expenses	$ 298.97	
Advisory Committee, Expenses	794.55	
Secretary's Office (Tallahassee)	1,310.74	
Plant Commissioner's Office (Gainesville)	13,601.12	
Department of Entomology	4,573.50	
Department of Nursery Inspection	10,793.17	
Department of Plant Pathology	2,189.42	
Department of Port and Railway Inspection	1,438.35	
Unexpended balance reverting	.18	
Total		$35,000.00

—Plant Commissioner.

Expenditures

For Salaries	$ 8,344.31	
For Office Expenses	507.64	
For Traveling Expenses	1,022.00	
For Printing Bulletins	678.20	
For General Supplies	724.74	
For Miscellaneous Expenses	221.29	
Total Expenses to September 30, 1916		11,498.18**
Balance Unexpended		$ 23,501.82

Respectfully submitted,

J. G. KELLUM, Secretary."

ESTIMATES

The following estimates on the appropriation required for the general work of the Plant Board during each of the ensuing fiscal years are based upon furnishing the farmers and fruit growers of the State with that protection against injurious insects and diseases contemplated by the Florida Plant Act of 1915 and which means to them countless thousands of dollars saved from the ravages of these pests, as well as thousands more from pests which are certain to enter Florida from other States and countries should this protection not be afforded.

The continuing appropriation of $35,000.00 per annum, made by the last Legislature for carrying out the general provisions of the Plant Act, has been found totally inadequate for the purpose. The reason for this lies largely in the fact that the doors of Florida were wide open for years, with no protection being afforded its agricultural industries, with the result that the agricultural pests already introduced into the State annually levy a toll of from 15 to 25 per cent on the general farm crops and from 40 to 60 per cent on the fruit and truck crops.

Unfortunately practically all supplies used by the Plant Board in its work, such as paper, stationery, laboratory equipment, chemicals, disinfectants, etc., have greatly advanced in price

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**The disbursement of this item, by departments, was as follows:

Plant Board, Expenses	$ 0.00
Advisory Committee, Expenses	56.60
Secretary's Office	412.45
Plant Commissioner's Office	4,222.69
Department of Entomology	1,427.47
Department of Nursery Inspection	2,277.26
Department of Plant Pathology	521.48
Department of Port and Railway Inspection	2,580.23
Total, May 1, to Sept. 30, 1916	$11,498.18

—Plant Commissioner.

since the appropriation was made. The rapid upward tendency of salaries being paid by commercial organizations has also made it extremely difficult, and in many cases impossible, for the Plant Board to retain efficient employees at the salaries which its resources permit it to pay. Despite the increased cost of supplies and of services the following estimates are based upon actual experience during the past 18 months.

GENERAL FUND

Estimated Expenses Per Annum

PLANT BOARD

Traveling Expenses of Board Members	$ 300.00	
Postage and Telegrams, Board Members	50.00	
Total		$ 350.00

SECRETARY'S OFFICE

Salary of Secretary	$ 600.00	
Salary of Assistant Secretary	600.00	
Postage and Stationery	100.00	
Total		1,300.00

PLANT COMMISSIONER'S OFFICE

Salaries:		
Plant Commissioner	$ 4,000.00	
1 Chief Clerk	1,500.00	
1 Filing Clerk at $60.00 per month	720.00	
2 Stenographers at $75.00 per month, each	1,800.00	
2 Stenographers at $70.00 per month, each	1,680.00	
1 Janitor at $30.00 per month	360.00	
Total, Salaries		$ 10,060.00
Traveling Expenses, Plant Commissioner	$ 450.00	
Postage and Stamped Envelopes	1,050.00	
Telephone and Telegrams	108.00	
Letterheads, Plain White Paper, Envelopes, etc	165.00	
Office Desks, Tables and Chairs	115.00	
Filing Furniture	140.00	
Filing Folders, Guide and Record Cards, Blank Books, etc.	180.00	
Typewriters and Typewriter Maintenance	325.00	
Repairs and Maintenance of Rooms Occupied at University of Florida, and Equipment of Storerooms and Laboratory in Attic of Language Hall	75.00	
Express, Drayage and Freight	140.00	
Multigraph Supplies and Maintenance	185.00	
Publication of Quarterly Bulletin,* 4 Issues, 20,000 Copies Per Issue, at $800.00 Per Issue	3,200.00	
Postage on Quarterly Bulletin at Second-Class Rate, 4 Issues at $18.00 Per Issue	72.00	

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*In lieu of all other expenses for publishing bulletins, except rules of the Board as adopted, and official notices to transportation companies.

Publication of Plant Board "Circulars" Containing Rules, Regulations and Public Notices of the Board as Adopted, 12 Issues, 5,000 Copies Each, at $26.00 Per Issue	312.00	
1 Addressing Machine and Accessories	1,080.00	
Electricity,** 12 Months, at $5.00 Per Month	60.00	
Heat,** 4 Months, at $9.00 Per Month	36.00	
Reference Books and Agricultural and Technical Publications***	260.00	
		7,953.00
Total, Plant Commissioner's Office		$ 18,013.00

DEPARTMENT OF NURSERY INSPECTION

Salaries:		
Nursery Inspector (Chief of the Department)	$ 2,250.00	
12 Assistant Inspectors at $1,200.00	14,400.00	
2 Stenographers at $75.00 Per Month	1,800.00	
1 Stenographer at $70.00 Per Month	840.00	
Total, Salaries		$ 19,290.00
Traveling Expenses:		
Nursery Inspector	$ 375.00	
12 Assistant Inspectors at $60 Per Month Average	8,640.00	
Postage	720.00	
Stationery	145.00	
Telegrams	90.00	
Typewriters, Maintenance, Office Furniture, Filing Material and Record Blanks	325.00	
		10,295.00
Total, Department of Nursery Inspection		$ 29,585.00

DEPARTMENT OF PORT AND RAILWAY INSPECTION

Salaries:		
Port and Railway Inspector (Chief of the Department)	$ 2,000.00	
4 Deputy Inspectors at $1,500.00	6,000.00	
2 Deputy Inspectors at $1,200.00	2,400.00	
1 Deputy Inspector at $ 600.00	600.00	
2 Deputy Inspectors at $ 240.00	480.00	
1 Stenographer at $900.00	900.00	
Total, Salaries		$ 12,380.00
Traveling Expenses:		
Port and Railway Inspector	$ 750.00	
3 Deputy Inspectors at $600.00	1,800.00	
Postage	150.00	
Telegrams	40.00	
Stationery	65.00	
Port Expenses (Boat Hire, Street Car Fare, Quarantine Tags, Labor, etc.)	250.00	

**Payable to the University of Florida.

***The Plant Board funds have not heretofore permitted of the purchase of reference works, which are urgently needed.

Publication of "Port and Railway Inspection Notices," Estimated 5 Issues, of 5,000 Copies Each, at $21.50 Per Issue	107.50	
Express, Drayage and Freight	25.00	
		3,187.50
Total, Department of Port and Railway Inspection		$ 15,567.50

PARCELS-POST PLANT INSPECTION*

Salary, 1 Deputy Inspector	$ 1,200.00	
Disinfectants, Fumigating Boxes, Tags, etc.	400.00	
Drayage on Parcel Post Packages for Inspection, Between Post Office and University at Gainesville, at $15.00 Per Month	180.00	
Total, Parcels-Post Plant Inspection		$ 1,780.00

DEPARTMENT OF ENTOMOLOGY

Salaries:		
Entomologist (Chief of the Department)	$ 2,500.00	
1 Assistant Entomologist	1,200.00	
Labor	220.00	
		$ 3,920.00
Traveling Expenses:		
Entomologist	$ 400.00	
Assistant Entomologist	350.00	
		750.00
Postage	$ 310.00	
Laboratory Supplies	460.00	
Express, Freight and Drayage	95.00	
Reference Books	160.00	
Furniture	200.00	
Special Laboratory Equipment (Benches, Pots, Tubs, etc.)	85.00	
Observation Cages for Life History Work	150.00	
Photographic Supplies	130.00	
Insect Cases, Labels and Record Files	110.00	
Chemical and Laboratory Reagents	50.00	
		1,750.00
Total, Department of Entomology		$ 6,420.00

DEPARTMENT OF PLANT PATHOLOGY

Salaries:		
Plant Pathologist (Chief of Department)	$ 3,000.00	
1 Assistant Plant Pathologist	2,500.00	
		$ 5,500.00
Traveling Expenses:		
Plant Pathologist	$ 550.00	
Assistant Plant Pathologist	240.00	

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*Under an order issued by the Third Assistant Postmaster-General on October 24, 1916, all mail shipments of plants and plant products addressed for delivery at Florida post offices are required sent to Gainesville for inspection by the State Plant Board.

Equipment of Laboratory at Gainesville	900.00	
Postage	125.00	
Stationery	60.00	
Reference Books and Publications	110.00	
Photographic Equipment (Camera, Lenses, etc.)	140.00	
Photographic Plates, Paper and Chemicals	35.00	
		2,160.00

Tropical Laboratory, Redland, Dade County

Renewal of Glassware, Apparatus, etc.	$ 125.00	
1 Typewriter	100.00	
Gasoline for Gas Plant	80.00	
Freight and Drayage	60.00	
Reference Books	30.00	
Repairs, Laboratory Building and Outdoor Equipment	30.00	
Trees and Plants for Use in Experiments	40.00	
		465.00
Total, Department of Plant Pathology		$ 8,125.00

SUMMARY

Plant Board Expenses	$ 350.00	
Secretary's Office	1,300.00	
Plant Commissioner's Office	18,013.00	
Department of Nursery Inspection	29,585.00	
Department of Port and Railway Inspection	15,567.50	
Parcels-Post Plant Inspection	1,780.00	
Department of Entomology	6,420.00	
Department of Plant Pathology	8,125.00	
Grand Total, General Fund Per Annum		$ 81,140.50

CITRUS CANKER ERADICATION

The actual cost of conducting the canker eradication work in Florida from May 1 to September 30, 1916, five months, was $179,671.51*, or $35,934.30 per month. This was at the rate of $431,211.60 per annum, but despite the practice of every possible economy that could be devised the number of men em-

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*This amount was expended as follows:

	Out of Plant Act Special Fund			Out of Federal Appropriations, by Bureau of Plant Industry			
Month 1916	Salaries	Trav. Expense	Supplies	Salaries	Trav. Expenses	Supplies	Total for Month
May	$ 35.00	$248.09	$183.99	$19,281.05	$4,902.68	$1,290.07	$25,940.88
June	155.55	555.12	278.98	24,174.96	6,587.62	1,470.74	33,222.97
July	102.50	141.48	73.99	27,107.05	8,478.96	1,616.83	37,520.81
August	101.67	42.72	137.25	27,852.45	8,686.97	3,919.60	40,740.66
September	260.33	71.56	95.99	27,919.88	9,517.53	4,380.90	42,246.19
Grand Total							$179,671.51

ployed was not sufficient to secure the maximum efficiency and speed in stamping out the various outbreaks. It is a certainty that it will require a continuation of this work on at least as extensive a scale as at present for two and one-half years to come. Assuming that the Bureau of Plant Industry, United States Department of Agriculture, will provide for the continuation of this work from the time of this report until April 30, 1917, it is seen that sufficient funds for continuing the inspection and eradication work for two years from the latter date must be available. Based upon the actual cost of conducting this work during 1916 and without anticipating any unusual developments or emergencies, the sum of $431,200.00 per annum, or $862,400.00 for the two-year period, will be required. Assuming, again, that the Federal Government will co-operate to the extent of paying one-half the cost of the eradication work during the two-year period, through appropriations made by Congress, a minimum of $431,200.00 must be made available from other sources.

I therefore recommend that your honorable Board present to His Excellency, the Governor of Florida, and to the members of the Legislature, the advisability of appropriating not less than $431,200.00 as a special fund with which to continue the work of eradicating citrus canker.

GRAND SUMMARY OF FUNDS REQUIRED

General Fund, Fiscal Year ending April 30, 1918	$ 81,140.50
General Fund, Fiscal Year ending April 30, 1919	81,140.50
Special Fund for the Eradication of Citrus Canker	431,200.00
Grand Total	$593,481.00

Respectfully submitted,

WILMON NEWELL,
Plant Commissioner.

Gainesville, Fla.,
November 30, 1916.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING MARCH 31, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending March 31st, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING MARCH 31, 1917

Citrus grove trees inspected	3,451,027
Citrus nursery trees inspected	15,771,754
Inspectors employed	378
New properties showing infection	2
Total properties showing active infection	16
Grove trees found infected	27
Nursery trees found infected	7
Counties in which active infections were found	5

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,363
Nursery trees found infected since May, 1914	342,228
Number properties infected to March 31, 1917	443
Properties declared no longer "danger centers"	306
Properties still classed as "infected", March 31, 1917	137

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1917:

1914		1915		1916		1917	
		January	306	January	86	January	14
		February	165	February	21	February	4
		March	444	March	49	March	9
		April	408	April	49		
May	108	May	1042	May	338		
June	160	June	772	June	450		
July	275	July	651	July	349		
August	1313	August	1345	August	219		
September	767	September	618	September	124		
October	565	October	214	October	451		
November	773	November	494	November	131		
December	366	December	256	December	27		

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING MARCH 31, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

SHIPS AND VESSELS INSPECTED:			
From foreign ports		376	
From U. S. ports other than Florida		231	
From Florida ports		593	
Total			1200
SHIPMENTS INSPECTED:			
Arriving by water:			
Passed	45		
Treated and passed	11		
Returned to shipper	54		
Detained, subject to return	3		
Contraband destroyed	523		
			636
Arriving by express, freight, etc.:			
Passed	273		
Treated and passed	34		
Returned to shipper	15		
Detained, subject to return	51		
Contraband destroyed	39		
			412
Total shipments inspected			1048

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested
Cactus scale	Cactus	Florida	1
California black scale	Hibiscus	Florida	1
California red scale	Oleander	Florida	1
Camphor thrips	Camphor	Florida	1
Chaff scale	Palm	Georgia	1
Cottony cushion-scale	Croton	Florida	1
Cottony cushion-scale	Croton	Cuba	2
Cottony cushion-scale	Avocado	Cuba	1
Cottony cushion-scale	Rose	Jamaica	1
Crown gall	Rose	South Carolina	1
Crown gall	Grape	Florida	1
Crown gall	Peach	Georgia	1
Dictyospermum scale	Citrus	Spain	1
Florida wax-scale	Pear	Florida	1
Florida red scale	Citrus	Florida	2
Fern scale	Fern	Georgia	1
Mealy-bug	Citrus	Florida	1
Melanose	Citrus	Florida	1
Mango scale	Mango	Florida	1
Nematode root-knot	Apple	North Carolina	1
Nematode root-knot	Cherry	Georgia	1
Nematode root-knot	Fig	Florida	5

Insect or Disease	Occurring on	From	Number of shipments infested
Nematode root-knot	Fig	Georgia	7
Nematode root-knot	Fig	South Carolina	7
Nematode root-knot	Fig	Texas	1
Nematode root-knot	Grape	Georgia	1
Nematode root-knot	Mulberry	Florida	2
Nematode root-knot	Papaya	Florida	1
Nematode root-knot	Peach	Florida	2
Nematode root-knot	Peach	Georgia	4
Nematode root-knot	Peach	South Carolina	1
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Plumbago	Florida	2
Nematode root-knot	Rose	South Carolina	1
Rufous scale	Tamarind	Cuba	1
Rufous scale	Unknown plant	Cuba	1
Red spider	Rose	Cuba	2
Peach-borer	Plum	South Carolina	1
Purple scale	Citrus	Florida	4
Papaya fruit-fly	Papaya	Cuba	1
Papaya fruit-fly	Papaya	Florida	3
Peach scale	Peach	Florida	1
San Jose scale	Apple	Georgia	1
San Jose scale	Apple	North Carolina	1
San Jose scale	Cherry	Kentucky	1
San Jose scale	Cherry	South Carolina	1
San Jose scale	*Crategus* sp.	North Carolina	1
San Jose scale	Mulberry	Florida	1
San Jose scale	Peach	Florida	2
San Jose scale	Peach	Georgia	5
San Jose scale	Peach	Illinois	2
San Jose scale	Peach	South Carolina	1
San Jose scale	Pear	Florida	1
San Jose scale	Plum	Florida	2
San Jose scale	Plum	Georgia	1
San Jose scale	Poplar	Georgia	1
Sugar-cane borer	Sugar-cane	Cuba	2
Whitefly	Avocado	Florida	1
Whitefly	Citrus	Florida	4

PARCEL POST PLANT INSPECTION

Under an Order issued by the Third Assistant Postmaster General, October 24, 1916, mail shipments of plants and plant products addressed for delivery at Florida postoffices are required sent to Gainesville for inspection by the State Plant Board. Inspection under this Order was commenced at the Gainesville postoffice November 4, 1916. Full details concerning this Order and the Act of Congress under authority of which it was issued will be found on page 154 of this issue.

NOVEMBER 4 TO DECEMBER 31, 1916

PARCELS INSPECTED:

Passed	165
Treated and passed	6
Returned to sender	0
Detained, subject to return	1
Infested or infected parcels destroyed	0
Total Parcels Inspected	172

PESTS AND DISEASES INTERCEPTED

Pest	Occurring on	From	Number of parcels infested
Florida red scale	Citrus	Florida	1
Long scale	Citrus	Florida	1
Purple scale	Citrus	Florida	2
Nematode root-knot	Fig	Florida	1

QUARTER ENDING MARCH 31, 1917

PARCELS INSPECTED:		
Passed	2294	
Treated and passed	30	
Returned to sender	551	
Detained, subject to return	12	
Infested or infected parcels destroyed	3	
Total Parcels Inspected		2890

PESTS AND DISEASES INTERCEPTED

Pest	Occurring on	From	Number of parcels infested
Borer	Walnut	Georgia	1
Peach-borer	Plum	Mississippi	1
Chaff scale	Citrus	Ohio	1
Crown gall	Rose	Ohio	15
Dictyospermum scale	Rubber	Ohio	1
Melanose	Citrus	Florida	1
Purple scale	Citrus	Florida	3
Nematode root-knot	Begonia	Ohio	10
Nematode root-knot	*Cissus discolora*	Ohio	1
Nematode root-knot	Coleus	Ohio	2
Nematode root-knot	Chrysanthemum	Ohio	15
Nematode root-knot	Cyclemen	Ohio	1
Nematode root-knot	Daisy	Ohio	16
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Geranium	Ohio	18
Nematode root-knot	Hibiscus	Ohio	17
Nematode root-knot	Honeysuckle	Ohio	3
Nematode root-knot	Ivy	Ohio	1
Nematode root-knot	Lemon verbena	Ohio	2
Nematode root-knot	*Primula obconica*	Ohio	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Peony	Ohio	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Rose	Ohio	481
Nematode root-knot	Rose	Pennsylvania	1
Nematode root-knot	Rose	North Carolina	1
Nematode root-knot	Salvia	Ohio	1
Nematode root-knot	Tomato	Florida	1
Nematode root-knot	Violet	Ohio	1
Nematode root-knot	Wistaria	Ohio	1
San Jose scale	Rose	Florida	1
Whitefly	Citrus	Florida	2
Whitefly	Citrus	Ohio	1

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* .... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER .... *Entomologist*
F. M. O'BYRNE .... *Nursery Inspector*
R. A. JEHLE .... *Asst. Plant Pathologist*
FRANK STIRLING .... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

CRISES IN THE CANKER ERADICATION WORK. On more than one occasion situations have arisen which have threatened the success of the eradication work but always ingenuity, hard work and quick adaptation to changing conditions have saved the day. Such a crisis presented itself in the early summer of 1915, when the number of canker-infected trees found in Dade County steadily increased each week. The Plant Board had to decide whether it would discontinue the fight in Dade County in order to cope with the disease in the balance of the State, before its funds became exhausted, or to continue the Dade County campaign with all available resources until the last moment. The latter policy was adopted and proved to be the correct one, for shortly afterwards the effectiveness of the work was shown by a falling off in the number of infections.

Between February 2 and 10, 1917, a severe cold spell visited Florida, amounting in some sections to a freeze of intensity, defoliating all citrus trees and in some cases killing young trees to the ground. Nothing of the kind had occurred since the beginning of canker eradication work. Inspection of the usual type, with all foliage killed, was of course impossible. Even before the cold weather moderated instructions went out to the District Inspectors calling for a thorough "cleaning up" in canker-infected properties. Fallen leaves were gathered up and burned and leaves remaining on the smaller trees were removed by hand and destroyed. Twigs and limbs injured by the cold were pruned out by the inspectors, the wounds disinfected and the surfaces of the trees disinfected by spraying with a weak solution of formaldehyde. The lowest temperature reached was not low enough to kill citrus canker bacteria and it was hoped, by these "sanitary" measures, to dispose of any dormant infections which may have existed in the dead and fallen leaves or in the pruned-out wood. It is too early yet to determine the results of this work but those in charge feel that the adaptation of methods to the new conditions have at least resulted in no ground being lost in the fight against canker. With the appearance of the new spring growth inspection work was resumed in the usual manner.

While this was going on another difficulty appeared. The Federal appropriation of a year ago was practically exhausted and word came from Washington to cut the canker eradication expenditures in Florida, for February, by more than $10,000. This emergency was promptly met by the inspectors themselves, many of whom made actual donations of the expenses incurred, while others voluntarily "laid off" in order to reduce the payroll. Twenty inspectors donated the use of their personally-owned automobiles. The use of these cars, reckoned at $1.50 per day per auto, amounted to $596.00. Traveling and other expenses defrayed by the inspectors during February amounted to $3,617.03 more. On February 28th orders came from Washington to discontinue all work as the appropriation was exhausted and Congress had not yet passed the Agricultural Bill providing new funds. For once the inspectors did not obey orders, for over two hundred of them continued their work, knowing full well they would receive no compensation. The time donated by the inspectors between March 1st and 4th amounted to $1,027.57. Expenses of eradication work personally defrayed by the men amounted to $237.62, while automobile usage was again donated to the value of $71.34, making a total of $5,549.56 in time and cash contributed by employees of the Plant Board and Bureau of Plant Industry between February 1st and March 4th.* As a result of these donations, together with payment of part of the February expenses by the State Plant Board, the canker eradication work was carried through without serious interruption or grave risk being incurred.

One would seek far to find an organization of men so devoted and loyal to a public cause.

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*The Agricultural Bill, making $180,000 available for canker eradication in the South, was passed by Congress on March 4th, one hour before adjournment, and was signed by President Wilson the same day.

RULES AND REGULATIONS MADE BY THE STATE PLANT BOARD PURSUANT TO THE FLORIDA PLANT ACT OF 1915, UP TO AND INCLUDING APRIL 9, 1917

PUBLIC NOTICE

Declaring Certain Insects and Diseases to Be Public Nuisances

*Under the provisions of the Florida Plant Act of 1915, Chapter 6885, approved April 30, 1915, the State Plant Board of Florida, in accordance with Section 5 of said Act, does declare the following insects and diseases, and each and every plant and thing infested or infected therewith, to be public nuisances:

Insect or Disease	Plants Likely to Become Infested or Infected
Avocado Weevil *(Heilipus lauri* Boh.*)*.	Avocado.
Banana Root Borer *(Sphenophorus (Cosmopolites) sordidus* Germar).	Banana. Sugar cane.
Banana Wilt Disease, or "Panama Disease" *(Fusarium* sp.*)*.	Banana.
Brown Rot *(Pythiacystis citrophora)*.	Lemons. Oranges.
Brown-tail Moth *(Euproctis chrysorrhaea* Linn*)*.	Apple *(Pyrus malus)*†. Apple, crab *(Pyrus coronaria)*. Apricot *(Prunus armeniaca)*. Ash, Black *(Fraxinus nigra)*. Ash, Blue *(Fraxinus quadrangulata)*. Ash, Red *(Fraxinus pennsylvanica)*. Ash, White *(Fraxinus americana)*. Barberry *(Berberia vulgaris)*. Basswood *(Tilia americana)*. Beach Plum *(Prunus maritima)*. Beech, American *(Fagus grandifolia)*. Birch, Black. Birch, Gray. Birch, Paper. Birch, Yellow. Blackberry *(Rubus villosus)*. Box-elder *(Acer negundo)*. Cherry *(Prunus avium)*. Cherry, wild black *(Prunus serotina)*. Chestnut *(Castanea dentata)*. Chokeberry *(Aronia melanocarpa)*. Choke Cherry *(Padus nana)*. Crataegus, all species. Creeper, Virginia *(Ampelopsis quinquefolia)*. Currant *(Ribes rubrum)*. Elm, American *(Ulmus americana)*. Elm, Cork Elm, English Elm, Scotch Elm, Slippery. Gooseberry *(Ribes grossularia)*. Grape *(Vitis cordifolia)*. Hophornbeam *(Ostrya virginica)*.

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*Adopted May 4, 1915. Amended Feb. 14, 1916, June 5, 1916, Aug. 14, 1916, and Jan. 8, 1917.

† List from data furnished by the Bureau of Entomology, U. S. D. A.

Insect or Disease	**Plants Likely to Become Infested or Infected**
	Hornbeam *(Carpinus caroliniana)*.
	Maple, Cut-leafed.
	Maple, Red.
	Maple, sugar *(Acer saccharinum)*.
	Maple, sycamore *(Acer pseudo-platanus)*.
	Maple, white *(Acer dasycarpum)*.
	Oaks *(Quercus* sp.*)*.
	Peach *(Prunus persica)*.
	Pear *(Pyrus communis)*.
	Plum *(Prunus domestica)*.
	Pyrus pinnatifida.
	Quince *(Cydonia vulgaris)*.
	Quince, Japan *(Cydonia japonica)*.
	Raspberry *(Rubus strigosus)*.
	Rose *(Rosa nitida)*.
	Shadbush *(Amelanchier canadensis)*.
	Spiraea *(Spiraea thunbergii)*.
	Sumach, Mountain.
	Sumach, Smooth.
	Sumach, Stag-horn.
	Walnut, black *(Juglans nigra)*.
	Weigela rosea.
	Willow, weeping *(Salix babylonica)*.
	Wistaria *(Wistaria consequana)*.
	Witch-hazel *(Hamamelis virginiana)*.
Citrus Canker *(Pseudomonas citri* Hasse*)*.	Citrus trees and plants, including the following:
	Bergamont *(Citrus bergamia)*. Includes various kinds of medicinal citrus
	Bigarade orange *(C. vulgaris)*. Includes the bittersweet, sour and others of this type.
	Citron *(C. Medica)*. Includes various varieties of citrons; also cedrat.
	Grapefruit, or Pomelo *(C. decumana)*.
	Hybrids. Includes the hybrids between various species of citrus—known under different names such as Morton, Rusk, Citrange, Pomerange, Tangelo, etc.
	Kumquat *(C. japonica)*. Includes the various kinds of kumquats.
	Lemon *(C. limonia)*. Includes various varieties of lemon, also rough lemon, everbearing lemon, ponderosa lemon.
	Lime *(C. limetta)*. Includes various varieties known as Key lime, Mexican lime, West Indian lime, etc.
	Mandarin Orange *(C. nobilis)*. This includes all varieties of "kid glove" oranges grown in Florida, such as Satsuma, Tangerine, King, Oneco, etc.

Insect or Disease	**Plants Likely to Become Infested or Infected**
	Otaheite *(C. sinensis)*.
	Pomelo—See Grapefruit.
	Shaddock *(C. decumana)*. As separate from Pomelo. This includes several varieties.
	Sweet Orange *(C. aurantium)*. This includes all round oranges commonly grown for commercial purposes in Florida.
	Trifoliate Orange or "*Citrus trifoliata*" *(Poncirus trifoliata)*.
Cocoanut Bud-rot *(Bacillus coli* var.*)*.	Cocoanut.
Cotton Square-weevil *(Anthonomus vestitus* Boh.*)*.	Cotton.
Dictyospermum Scale *(Chrysomphalus dictyospermi* (Morg.)*)*.	Arbor-vitae.
	Auracaria sp.
	Cape Jasmine.
	Citrus.
	Cycas.
	Erythrina indica.
	Ficus sp.
	Kentia belmoreana.
	Latania.
	Mango.
	Rose.
Gypsy Moth *(Porthetria dispar* Linn.*)*.	Alder, speckled *(Alnus incana)*.*
	Apple *(Pyrus malus)*.
	Ash, mountain *(Pyrus americana)*.
	Aspen, American *(Populus tremuloides)*.
	Aspen, large-toothed *(Populus grandidentata)*.
	Balm-of-Gilead *(Populus balsamifera)*.
	Beech, American *(Fagus grandifolia)*.
	Birch, gray *(Betula populifolia)*.
	Birch, paper *(Betula papyrifera)*.
	Birch, red *(Betula nigra)*.
	Box elder *(Acer negundo)*.
	Barberry, European *(Berberis vulgaris)*.
	Bayberry *(Myrica carolinensis)*.
	Birch, black *(Betula lenta)*.
	Birch, yellow *(Betula populifolia)*.
	Blueberry, low *(Vaccinium vacillans)*.
	Blueberry, tall *(Vaccinium corymbosum)*.
	Chestnut *(Castanea dentata)*.
	Cherry, sweet *(Prunus avium)*.
	Cherry, wild black *(Prunus serotina)*.
	Cherry, wild red *(Prunus virginiana)*.
	Chokeberry *(Aronia melanocarpa)*.
	Chokecherry *(Padus nana)*.
	Cottonwood *(Populus deltoides)*.
	Cranberry, American *(Oxycoccus macrocarpus)*.
	Elm, American *(Ulmus americana)*.

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* List used through courtesy of the Federal Horticultural Board.

Insect or Disease	**Plants Likely to Become Infested or Infected**
	Elm, European *(Ulmus campestris).*
	Elm, slippery *(Ulmus fulva).*
	Fern, sweet *(Comptonia peregrina).*
	Gum, sweet, or red *(Liquidamber styraciflua).*
	Gum, black *(Nyssa sylvatica).*
	Gale, sweet *(Myrica gale).*
	Hawthorn *(Crataegus* sp.*).*
	Hazelnut *(Corylus americana).*
	Hazelnut, Beaked *(Corylus rostrata).*
	Hemlock *(Tsuga canadensis).*
	Hickory, bitternut *(Hickoria cardiformis).*
	Hickory, mockernut *(Hickoria alba).*
	Hickory, pignut *(Hickoria glabra).*
	Hickory, shagbark *(Hickoria ovata).*
	Hornbeam, American *(Carpinus caroliniana).*
	Hophornbeam *(Ostrya virginica).*
	Larch, American *(Larix laricina).*
	Larch, European *(Larix decidua).*
	Linden, American *(Tilea americana).*
	Linden, European *(Tilea* sp.*).*
	Maple, Norway *(Acer plantanoides).*
	Maple, red or swamp *(Acer rubrum).*
	Maple, silver *(Acer saccharinum).*
	Maple, sugar *(Acer saccharum).*
	Oak, black *(Quercus velutina).*
	Oak, rock chestnut *(Quercus primus).*
	Oak, dwarf chestnut *(Quercus prinoides).*
	Oak, burr *(Quercus macrocarpa).*
	Oak, pin *(Quercus palustris).*
	Oak, post *(Quercus stellata).*
	Oak, red *(Quercus rubra).*
	Oak, scarlet *(Quercus coccinea).*
	Oak, bear *(Quercus ilicifolia).*
	Oak, shingle *(Quercus imbricaria).*
	Oak, swamp white *(Quercus bicolor).*
	Oak, white *(Quercus alba).*
	Poplar, Lombardy *(Populus nigra).*
	Pine, pitch *(Pinus rigida).*
	Pine, red *(Pinus resinosa).*
	Pine, Scotch *(Pinus sylvestris).*
	Pine, western white *(Pinus monticola).*
	Pine, white *(Pinus strobus).*
	Plum, beach *(Prunus maritima).*
	Pear *(Pyrus communis).*
	Poplar, silver *(Populus alba).*
	Rose, pasture *(Rosa virginiana).*
	Service-berry *(Amelanchier canadensis).*
	Sumac, mountain *(Rhus copallina).*
	Sumac, scarlet *(Rhus glabra).*
	Sumac, staghorn *(Rhus hirta).*
	Spruce, black *(Picea mariana).*
	Spruce, Norway *(Picea abies).*
	Spruce, red *(Picea rubens).*
	Spruce, white *(Picea canadensis).*

Insect or Disease	Plants Likely to Become Infested or Infected
	Sassafras *(Sassafras sassafras)*.
	Willow, white *(Salix alba)*.
	Willow, glaucous *(Salix discolor)*.
	Willow, sandbar *(Salix interior)*.
	Witch-hazel *(Hamamelis virginiana)*.
Mediterranean Fruit Fly *(Ceratitis capitata* Wied.*)*.	Almond *(Amygdalus communis)*.*
	Amatungula *(Carissa bispinosa) (C. arduina)*.
	Apple *(Malus sylvestris) (Pyrus malus)*.
	Apricot *(Prunus armeniaca)*.
	Avocado *(Persea americana) (P. gratissima)*.
	Banana *(Musa sapientium)*.
	Barbados gooseberry *(Pereskia aculeata)*.
	Barbary Fig *(Opuntia vulgaris)*.
	Bean *(Phaseolus vulgaris)*.
	Belladonna *(Atropa belladonna)*.
	Carica quercifolia.
	Carambola *(Averrhoa carambola)*.
	Cayenne or Surinam cherry *(Eugenia uniflora) (E. michelii)*.
	Cerbera thevetia (Thevetia neriifolia).
	Cherimoya *(Annona cherimola)*.
	Chinese inkberry *(Cestrum* spp.*)*.
	Chrysobalanus ellipticus.
	Citron *(Citrus medica)*.
	Cocoa-plum *(Chrysobalanus icaco)*.
	Coffee *(Coffea arabica)*.
	Eggplant *(Solanum melongena)*.
	Elengi tree *(Mimusops elengi)*.
	Fig *(Ficus carica)*.
	Granadilla *(Passiflora quadrangularis)*.
	Grape *(Vitis vinifera)*.
	Grapefruit *(Citrus grandis) (C. decumana)*.
	Grumixiama or Brasilian cherry *(Eugenia dombeyi) (E. brasiliensis)*.
	Guava *(Psidium guajava)*.
	Japanese persimmon *(Diospyros kaki)*.
	Jerusalem cherry *(Solanum capsicastrum)*.
	Kafir-plum *(Harpephyllum caffrum)*.
	Kei apple *(Dovyalis caffra) (Aberia caffra)*.
	Kumquat *(Fortunella japonica) (Citrus japonica)*.
	Lemon *(Citrus limonia) (C. medica* var. *limon)*.
	Lime *(Citrus aurantifolia) (C. limetta)*.
	Loquat *(Eriobotrya japonica)*.
	Malay apple *(Caryophyllus malaccensis)*. *(Eugenia malaccensis)*.
	Mammee apple *(Mammea americana)*.

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* List used through courtesy of the Federal Horticultural Board.

Insect or Disease	**Plants Likely to Become Infested or Infected**
	Mandarin orange (*Citrus nobilis deliciosa*).
	Mango (*Mangifera indica*).
	Medlar (*Mespilus germanica*) (*Pyrus germanica*).
	Natal plum (*Carissa grandiflora*).
	Noronhia emarginata.
	Orange jessamine (*Chalcas exotica*) (*Murraya exotica*).
	Papaya (*Carica papaya*).
	Passion flower (*Passiflora caerulea*).
	Peach (*Amygdalus persica*) (*Prunus persica*).
	Pineapple (*Ananas sativus*).
	Prickly pear (*Opuntia tuna*).
	Quince (*Cydonia oblonga*). (*Pyrus cydonia*).
	Red peppers (*Capsicum* spp.)
	Rose apples (*Caryophyllus jambos*). (*Eugenia jambos*).
	Round Kamani Mastwood (*Calophyllum inophyllum*).
	Sapodilla, Chicle (*Achras sapota*).
	Sour cherry (*Prunus cerasus*).
	Sour or Seville Orange (*Citrus aurantium*).
	Soursop (*Annona muricata*).
	Squash, pumpkin, gourd (*Cucurbita* spp.)
	Starapple (*Chrysophyllum cainito*).
	Strawberry guava (*Psidium cattleyanum*).
	Sweet orange (*Citrus sinensis*).
	Tomato (*Lycopersicon esculentum*).
	Winged kamani (*Terminalia catappa*).
Mexican Orange Maggot, or Morelos Fruit Worm (***Anastrepha (Trypeta) ludens* Loew.**).	Guava (*Psidium guajava*).*
	Mango (*Mangifera indica*).
	Orange (*Citrus sinensis* and *C. aurantium*).
	Peach (*Amygdalus persica*).
	Plum (*Prunus* spp.).
	Sapodilla (*Achras sapota*).
	Sweet lime (*C. limetta*).
Mango Seed Weevil (***Cryptorhynchus mangifera*** Fab.).	Mango fruit and seed.
Pineapple Black Weevil (***Metamasius ritchiei*** Marshall).	Pineapple.
Pink Bollworm (***Gelechia gossypiella*** Saund.).	Cotton.
Spiny Citrus White-fly (***Aleurocanthus woglumi*** Ashby).	Avocado.
	Capparis spp.
	Cestrum nocturnum.
	Citrus.
	Coffee.
	Guava.
	Lignum vitae.
	Mango.
	Salacea reticulata.

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* List used through courtesy of the Federal Horticultural Board.

Rule 1[*]. Inspectors employed by the Plant Board shall examine citrus plants and plant products in nurseries, orchards and other properties within the State of Florida, in order to determine whether these plants or plant products are infected with citrus canker, and shall report their findings to the Plant Board.

Rule 2[*]. The planting, transplanting or otherwise moving of any plants which are infected with citrus canker, or which, in the opinion of an inspector of the Plant Board, are likely to carry canker infections, is prohibited.

Rule 3[†]. All plants found to be infected with citrus canker shall be entirely destroyed by burning, and without being cut, or otherwise handled or moved. Further, the ground shall be thoroughly burned for a distance of three feet beyond the utmost spread of the branches of the infected plant; provided, however, that the Plant Pathologist, acting under the direction of the Plant Commissioner, may carry on such experiments with infected trees as the Plant Commissioner may deem advisable, as looking toward the control and cure of citrus canker. Said experiments shall be conducted under such conditions as will not endanger healthy trees by the spread of citrus canker.

Rule 4[‡]. The movement of all trees and plants commonly known as nursery stock, including budwood and scions, which do not have attached thereto a proper certificate tag, issued by the State Plant Board, and which have not been prepared for movement in accordance with the Rules and Regulations of the State Plant Board, in other respects, is hereby prohibited.

Rule 4A[§]. The following insect pests and diseases are hereby declared to be especially injurious and are declared to be insect pests and diseases which should be controlled and their dissemination prevented, within the intent and meaning of Section 12 of the Florida Plant Act of 1915:

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
Anthracnose of Banana (*Gleosporium musarum*).	Banana.
Argentine Ant (*Iridomyrmex humilis* Mayr).	Fig, Orange.
Australian-pine-tree Borer (*Chrysobothris impressa* Fab.)	Australian pine (*Casuarina equisetifolia*).
Bay-tree White-fly (*Paraleyrodes perseae* Quaintance).	Avocado, Citrus, *Persea carolinensis*.
Blight (*Bacillus amylovorus*).	Apple, Loquat, Pear.
Blue-green Citrus Beetles (*Pachnaeus opalus* Oliv., *P. distans* Horn, *P. litus* Germar, and *P. azurescens* Gyllenhal).	Citrus.
Boll Weevil (*Anthonomus grandis* Boh.).	Cotton.
Bundle Blight (*Pseudomonas vascularum*).	Sugar cane.
California Red Scale (*Chrysomphalus aurantii* (Maskell)).	Citrus, Rose.
Camphor Thrips (*Cryptothrips floridensis* Watson).	Camphor.

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[*] Adopted May 4, 1915.
[†] Adopted May 4, 1915. Amended June 19, 1915.
[‡] Adopted May 4, 1915. Amended Feb. 14, Mar. 13, and April 10, 1916.
[§] Adopted April 10, 1916. Amended May 8, Aug. 14, and Oct. 13, 1916, and Jan. 8, Feb. 12, and Mar. 12, 1917.

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
Cane Leaf-hopper (*Perkinsiella saccharicida* Kirkaldy).	Sugar cane.
Cane Sharpshooter (*Delphax saccharivora* Westwood).	Sugar cane.
Chaff Scale (*Parlatoria pergandii* Comst.).	Citrus, Camellia, *Cocus plumosa*.
Chestnut Bark Disease (*Endothia parasitica*).	Chestnut.
Citricola Scale (*Coccus citricola* Campbell).	Citrus, Elm, Nightshade, Pomegranate, Walnut.
Citrus Mealy-bug (*Pseudococcus citri* (Risso)).	Begonia, *Bignonia* sp., Bottle Bush (*Callistemon lanceolatus*), *Bouvardia* sp., *Ceanothus integerrimus*, Citrus, Coleus, Coffee, Cotton, Croton, *Cyperus alternifolius*, English ivy, Ferns (*Filicales*), *Fuchsia*, Guadalupe Island Palm (*Erythea edulis*), *Habrothamnus*, *Ipomea*, *Learii*, Oleander, Peony, Poinsettia (*Euphorbia pulcherrimma*), Pineapple, Pumpkin, Purple Passion Flower (*Passiflora violacea*), *Solanum douglasii*, *Solanum jasminoides*, *Strelitzia gigantea*, *Strelitzia regina*, Tobacco, Variegated Wandering Jew.
Citrus Scab (*Cladosporium citri*).	Citrus.
Cloudy-winged White-fly (*Aleyrodes nubifera* Berger).	Citrus, Indian Laurel, *Ficus nitida*.
Cottony Cushion-scale (*Icerya purchasi* Maskell).	Acacias, Ambrosia, Apple, Apricot, Australian pine, Banyan, Careless weed, Castor Bean, *Chenopodium*, Citrus, Cocoanut palm, Coleus, Dwarf flowering almond, Fig, Goldenrod, Grape, Gumbo limbo, Locust, Magnolia, Mulberry, Myrtle, Nettle, Nightshade, Peach, Pecan, Pepper, Pine, Pomegranate, Potato, Purslane, Quince, Rosa de Montana, Rose-geranium, Roses, Royal Poinciana, Sapodilla, Sheperd's needle, Spanish Lime, Spanish Mulberry, Spearmint (*Melicocca bijuga*), Stone-crop (*Sidum* sp.), Sunflower, Sweet gum, Verbena, *Veronica*, Walnut, White Oak, Willow.
Crown Gall (*Pseudomonas tumefaciens*).	Apple, Grape, Oleander, Peach, Pear, Plum, Rose.
Cuban Laurel Thrips (*Gynaikothrips useli* Zimmerman).	Citrus, *Ficus nitida*.
Dieback of Pecan (*Botryospheaeria berengeriana*).	Pecan.
Florida Red Scale (*Chrysomphalus aonidum* Linn.).	*Aspidistra lurida*, *Auracaria bidwelli*, Australian oak (*Grevillea robusta*), Banana, *Begonia magnifica*, Camphor-tree, Cinnamon, Citrus, Cocoanut, Coffee, *Dictyospermum album*, Eucalyptus, *Ficus*

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
	elastica, Ficus nitida, Guava, *Ilex latifolia, Ilex lurida,* Japonica, Mammee apple *(Mammea Americana),* Mango, Oleander, Palms, *Pandanus, Rhododendron arboreum,* Rose.
Florida Wax-scale *(Ceroplastes floridensis* Comstock*).*	*Andromeda, Anona reticula, Anthurium,* Cinnamon, Citrus, *Euonymus japonicus,* Fig, Guava, *Ilex glabra,* Lignum-vitae, Mango, Myrtle, Oleander, Pomegranate, Quince, Red Bay, Tea.
Florida White-fly *(Aleyrodes floridensis* Quaintance*).*	Avocado, Guava.
Foot Rot *(Fusarium limonis).*	Citrus.
Gray Fungus Gummosis *(Botrytis vulgaris).*	Lemon.
Japanese Wax-scale *(Ceroplastes ceriferus* Anderson*).*	Camellia, Coffee, Gardenia, Hibiscus, Mango, *Myrica cerifera,* Mandarin, Orange, Persimmon, Tea.
Leaf Blotch *(Cercospora fusca).*	Pecan.
Little Peach.	Peach.
Long Scale *(Lepidosaphes gloverii* (Packard)*).*	Citrus, *Magnolia fuscata.*
Mango Scale *(Pulvinaria psidii* Maskell*).*	Citrus, Fig, Guava, Henna Bush, Loquat, Mango, Mastic, Omelet tree *(Blighia sapoda),* Sapodilla, Satinleaf, Star-apple, Wild Rubber.
Melanose *(Phomopsis citri).*	Citrus.
Nursery Blight *(Phyllosticta caryae).*	Pecan.
Oriental Peach Moth *(Laspeyresia molesta* Quaintance*).*	Cherry, Japanese flowering cherry, Peach, Plum.
Papaya Fruit Fly *(Toxotrypana curvicauda* Gerstaecker*).*	Papaya *(Carica papaya).*
Peach Rosette.	Peach.
Peach Yellows.	Peach.
Pear Thrips *(Euthrips pyri* Daniel*).*	Pear.
Pecan Budworm *(Proteopteryx deludana* Clemens*).*	Hickory, Pecan.
Pecan Case-bearer *(Acrobasis nebulella* Riley*).*	Hickory, Pecan, Walnut, Wild Crab *(Crataegus).*
Pecan Girdler *(Oncideres cingulata* Say*).*	Hickory, Pecan, Persimmon, Rose, Walnut.
Pecan Rosette.	Pecan.
Pecan Scab. *(Fusicladium effusum).*	Pecan.
Pecan-tree Borer *(Sesia scitula* Harris*).*	Chestnut, Dogwood, Hickory, Oak, Pecan.
Powdery Scab.	Irish Potato.
Purple Mite *(Tetranychus mytilaspidis* Riley*).*	Citrus.

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
Purple Scale *(Lepidosaphes beckii* (Newman)*).*	*Banksia integrifolia, Cercidiphyllum japonicum,* Citrus, Croton, *Eleagnus,* Fig, *Ilex cornuta,* Oak, Olive, *Pomaderris apetala, Taxus cuspidata.*
Putnam's Scale *(Aspidiotus ancylus* (Putnam)*).*	Apple, Ash, Beech, Bladdernut, Cherry, Currant, Hackberry, Linden, Maple, Oak, Osage orange, Peach, Pear, Pecan, Plum, Quince, Snowball, Willow.
Pyriform Scale *(Protopulvinaria pyriformis* Ckll.*).*	Avocado, Cape Jasmine, English ivy, Guava, *Rhyncospermum.*
Red-banded Thrips *(Heliothrips rubrocintus* Giard*).*	Avocado, Guava, Mango.
Red and Black Citrus Weevil *(Praepodes vittatus* Linn., var. *rubrovittatus* Jekel*).*	Citrus.
Root Knot *(Heterodera schachti* Schmidt**).*	*Aloysia citriodora,* Asparagus, Banana, Bean, Beet, Begonia, Cabbage, Cantaloupe, Careless weed, Carrot, Catalpa, Cauliflower, Celery, Chrysanthemum, *Cissus discolora,* Coleus, Cotton, Cowpeas (most), Cucumber, Cyclamen, Daisy, Eggplant, Fig, Geranium, Grapes (old world), Hibiscus, Honeysuckle, Irish potato, Ivy, Japanese persimmon, Kale, Lettuce, Mulberry, Mustard, Okra, Peach, Peanut, Peas, Pecan, Peony, Papaya, Pepper, Pineapple, Pokeweed, *Primula obconica,* Quince, Radish, Rape, Rose, Salvia, Soy bean, Squash, Sweet potato, Sugar cane, Tobacco, Tomato, Violet, Watermelon, Wistaria.
Rot of Citrus *(Diplodia natalensis).*	Citrus.
Rufous Scale, or West Indian Red Scale *(Selenaspidus (Aspidiotus) articulatus* (Morg)*).*	Avocado, Citrus, Coffee, *Cordyline terminalis,* Custard apple, *Dictyosperma album, Ficus, Gardenia,* Jasminum, Mahogony, Mignonette bush *(Lawsonia), Pandanus,* Rose, Star apple, Tamarind.
San Jose Scale *(Aspidiotus perniciosus* Comst.*).*	Acacia, *Actinidia,* Alder, Almond, American linden, Apple, Apricot, Ash, Black walnut, Carolina poplar, *Catalpa speciosa,* Cedar, Chestnut, *Citrus trifoliata,* Cotoneaster, Crab-apple, Crataegus, Currant, Cut-leaved birch, Dogwood, Elm, English walnut, English willow, *Eucalyptus corynocalyx,* Euonymus, European linden, Golden-leaved poplar, Golden willow, Gooseberry, Hawthorn, Huckleberry, Japan plum, Japanese quince, Japan walnut, Juneberry, Laurel, Laurel-leaved willow, Lemon, Lime, Lombardy poplar, *Lonicera xylosteum,*

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* "*Heterodera radicicola* (Müller) Atkinson."

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
	Maple, Milkweed, Orange, Osage orange, *Prunus Avium*, Peach, Pear, Pecan, Persimmon, Poplar, *Prunus domestica*, Plum, *Prunus pissardi*, *Prunus maritima*, *Ptelea trifoliata*, Quince, Raspberry, Rose, Snowball, Spiraea, Spruce, Strawberry, Sumac, *Symphoricarpus racemosus*, Weeping Willow.
Scab (*Actinomyces chromogenus*).	Irish potato.
Scaly Bark (*Cladosporium herbarum*, var. *citricolum*).	Citrus.
Sericeous Palm Weevil (*Metamasius sericeus* Ol.).	Cocoanut palm, Royal palm, Sugar cane.
Six-spotted Mite (*Tetranychus sexmaculatus* Riley).	Citrus.
Snow Scale (*Chionaspis citri* Comst.).	Citrus, *Euonymus latifolius*, *Osmanthus*.
Soft Brown Scale (*Coccus hesperidum* Linn.).	*Abutilon*, *Morus nigra*, Box, Camellia, Cinnamon, Citrus, *Clematis flammula*, *Convolvulus tricolor*, *Cycas revoluta*, Holly, Ivy, Jasmine, Laurel, Mimosa, Myrtle, Oleander, Phlox.
Stem-end Rot (*Phomopsis citri*).	Citrus.
Striped Citrus Weevil (*Diaprepes abbreviatus* Linn, var. *spengleri* Linn.).	Citrus.
Sugar-cane Borers (*Diatraea saccharalis crambidoides* Fab. and *D. zeacolella* Dyar).	Corn (maize), Johnson grass, Sorghum, Sugar cane.
Sugar-cane Mealy-bug (*Pseudococcus calceolariae* Maskell).	Johnson grass, Sugar cane.
Sweet Potato Root-weevil (*Cylas formicarius* Oliv.).	Sweet potato, Morning glory.
Walnut Scale (*Aspidiotus juglans-regiae* Comst.).	Apple, Apricot, Cherry, Japan plum, Locust, Maple, Peach, Pear, Pecan, Walnut.
White Peach Scale (*Aulacaspis pentagona* (Targ.)).	Acanthus, Apricot, *Argyriea speciosa*, *Bryophyllum calycinum*, *Callicarpa lanata*, *Calotropis procera*, Cape gooseberry, Capsicum, *Carica papaya*, Cherry, China-Berry, *Cydus media*, Dwarf Cherry, Dwarf flowering almond, Dwarf peach, Fuchsia, Geranium, *Gossypium barbadense*, Granadilla, Grape, Hibiscus, *Hibiscus (Abelmoschus) esculentus*, Japanese varnish tree, Japan flowering cherry, Jassium, Locust, Morning glory, Mulberry, *Myoporum insulare*, Oleander, *Passiflora*

Insect, Pest or Disease	**Plants Likely to Become Infested or Infected**
	edulis, Peach, Pear, Pecan, Pelargonium, Persimmon, Plum, *Polygala myrtifolia*, Privet, Prune, *Prunus pandula*, *Prunus pseudo-ceraceus*, *Tylophora asthmatica*, Walnut, Yellow Jasmine.
White-winged White-fly. (*Aleyrodes citri* Riley & Howard).	Blackberry, Boston ivy, Button bush (*Cephalanthus occidentalis*), Cape jessamine (*Gardenia*), Cherry laurel, Chinaberry, Citrus, Coffee, English Ivy, *Ficus* sp., Green ash, Honeysuckle, Japonica (*Camellia japonica*), Jessamine (*Jasminum* sp.), Mexican orange (*Choisya ternata*), Oleander, Osage orange (*Maclura aurantiaca*), Persimmon (Japanese and native), Pomegranate, Portugal cherry, Prickly ash, Smilax, Scrub palmetto, Tree-of-Heaven, Trumpet flower (*Tecoma radicans*), *Viburnum nudum*, Water oak, Wild olive.
Withertip (*Colletotrichum gloesporioides*).	Avocado, Citrus, Mango.
Woolly White-fly (*Aleyrodes howardii* Quaintance).	Citrus.
Zizyphus Scale (*Parlatoria zizyphus* Lucas).	Citrus, Date-palm, *Zizyphus pinna-christi*.

Rule 4B.* No certificate shall be issued for the movement of any nursery stock until such stock shall have been inspected by an agent of the State Plant Board, and found to be apparently free from especially injurious insect pests or diseases. Should any especially injurious insect pest or disease be found, either on the nursery stock or on the premises, no certificate shall be issued until such insect pest or disease has been suppressed to the satisfaction of the Nursery Inspector. No certificate shall be issued when the nursery stock is exposed to infestation or infection from any especially injurious insect pest or disease that occurs within one-fourth mile from where any part of said nursery stock is located; provided, however, that the nurseryman may remove such stock under the direction of the Nursery Inspector, and under such precautions as he may specify, and provided, further, that nothing in this rule shall be construed as preventing the enforcement of quarantines to a greater distance than one-fourth mile in the case of properties declared by the Board to be infested or infected with any insect pest or disease declared to be a public nuisance.

Rule 4C.* All shipments of nursery stock, and every package thereof, transported within, into, or out of the State of Florida, shall be completely and securely boxed or covered to prevent infestation or infection by injurious insect pests or diseases. Carload shipments in bulk shall be in cars with openings effectually screened or closed.

Rule 4D.* All nursery stock, except those plants that will not stand defoliation, shall be completely defoliated, including leaf-stalks. Citrus must always be defoliated. All nursery stock shall be handled in such a manner that none of the leaves or clippings shall become mixed with any packing material.

Rule 4E.* All apple, pear, plum, and peach stock and all other host plants of San Jose scale which will stand fumigation, shall be fumigated with hydrocyanic-acid gas immediately before being delivered for transportation. Every nurseryman shall have his fumigation box or house completed and in order, with necessary chemicals at hand, ready to demonstrate his ability to fumigate nursery stock, at the time of inspection. No certificate shall be issued until the fumigating facilities have been approved by the Nursery Inspector.

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* Adopted April 10, 1916.

Rule 4F.* Any certificate may be revoked and all certificate tags recalled, at any time, for any violation of the provisions of the Florida Plant Act of 1915, of the Rules and Regulations of the State Plant Board, or of the requirements of the Nursery Inspection Department.

Rule 4G.* Until further notice is given, or at the discretion of the Nursery Inspector, the plants and parts thereof listed herewith, when apparently free from injurious insect pests and diseases, need not be inspected, but may be sold, exchanged or transported without a certificate tag attached. These exceptions do not apply to any plants or parts thereof imported from foreign countries, nor from the possessions of the United States not on the mainland of North America:

> Florida-grown forest trees and forest shrubs when not grown in a nursery; seed (except mango and avocado seed, and cotton seed in localities infested with the Cotton Boll Weevil); vegetable plants and other herbaceous plants; the roots, bulbs and tubers of vegetables and other herbaceous plants; cut flowers and pineapple plants.

Rule 5†. Every grove, nursery or separate plant situated in the State of Florida which has been found to be infected with citrus canker is hereby declared to be the center of an infected and dangerous zone, which zone shall extend for a mile in every direction from said center, and within which center and zone all citrus trees or citrus nursery stock are declared to be plants likely to carry and disseminate citrus canker. The planting or movement of citrus plants within such zone is hereby prohibited, and the movement of non-citrus plants from within such infected grove or nursery is likewise prohibited until such time as in the judgment of the Board such dangerous conditions may have ceased to exist; provided, that citrus trees or plants in such zone may be moved within a property located more than one-quarter of a mile from the center of such zone when moved under the supervision of an agent of the Plant Board, and provided, further, that citrus trees or plants from properly certified nurseries may be planted within such zone at distances exceeding one-half mile from the center thereof, and provided, further, that citrus trees or plants located within such zone may be budded by and with the consent and approval of the Plant Commissioner under such precautions and conditions as he may specify.

No certificate shall be issued for the movement of nursery stock from a nursery in which vehicles, teams, laborers or other persons, nursery implements or other things enter, that likewise enter or are used in any nursery or grove infected with citrus canker.

Rule 6‡. The Nursery Inspector shall be required to have prepared and shall arrange that any person entitled thereto may secure, under such conditions as the Nursery Inspector may name, certificates in proper form and serially numbered, to be affixed to any nursery stock the movement of which is permissible under the provisions of the Florida Plant Act of 1915.

The Nursery Inspector shall be further required to keep in his office exact records covering the issuance of all such certificates and the movement of nursery stock for which such certificates have been used, and the persons by whom such certificates have been secured shall be required to provide the Nursery Inspector, at any time and in such manner as he may designate, with the information necessary for the keeping of such records.

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* Adopted April 10, 1916.

† Adopted June 18, 1915. Amended Jan. 10, 1916, May 8, 1916, Aug. 14, 1916, and Oct. 13, 1916.

‡ Adopted June 19, 1915. Amended Nov. 8, 1915, Feb. 14, 1916, and April 10, 1916.

The Nursery Inspector shall have authority to call for the return of any unused certificates at his discretion.

The cost of printing such certificates shall be paid by the nurseryman to whom furnished and in case any certificates are recalled before used the cost thereof shall be refunded to the nurseryman.

The forms of certificates to be issued to cover the movement of nursery stock shall be as follows:

FORM NO. 1 (Serial Number)

Issued.., 191........

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY CERTIFICATE

The undersigned hereby certifies that the..
nursery stock, in the nurseries of..
located at.., Florida, has been thoroughly inspected. The stock, premises and adjacent properties have been found to be apparently free from especially injurious insect pests and diseases. The owner has agreed to completely defoliate (when possible) and to fumigate properly with hydrocyanic-acid gas, or to otherwise treat as directed, all stock sold or moved under this certificate, as provided in the Rules and Regulations.

A complete list of plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

Approved:

....
Plant Commissioner. Nursery Inspector.

FORM NO. 2 (Serial Number)

Issued.., 191........

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY DEALER'S CERTIFICATE

The undersigned hereby certifies that the nursery stock sold by ....of..., Florida is apparently free from injurious insect pests and diseases, and that the same may be transported under the provisions of the Florida Plant Act of 1915.

The undersigned further declares that..
has furnished him with names and addresses of the persons from whom and the localities where he purchased or obtained the nursery stock sold under this certificate.

A complete list of the plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

Approved:

....
Plant Commissioner. Nursery Inspector.

FORM NO. 3 (Serial Number)

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

PACKAGE CERTIFICATE

.................................., Fla., ..., 19.......

This is to certify that the contents of this package from.................................. of.., Florida, addressed to.. of.................................., State of.................................., have been carefully inspected and found to be apparently free from especially injurious insect pests and diseases and may be sold and transported under the provisions of the Florida Plant Act of 1915.

The owner has agreed to defoliate (when possible), and to properly disinfect as directed by the Inspector, the contents of this package.

A complete list of the plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

....
Nursery Inspector.

....
Inspector.

FORM NO. 4 (Serial Number)

Issued.., 191.......

FLORIDA STATE PLANT BOARD
Office of Nursery Inspector,
Gainesville, Fla.

NURSERY CERTIFICATE

The undersigned hereby certifies that the.. nursery stock in the nurseries of..located at.., Florida, has been thoroughly inspected.

The stock, premises and adjacent properties have been found to be apparently free from especially injurious insect pests and diseases, but are located in scaly-bark territory. The owner has agreed to completely defoliate (when possible) and to fumigate with hydrocyanic-acid gas, or to otherwise treat as directed, all stock sold or moved under this certificate, as provided in the Rules and Regulations.

A complete list of all plants transported under this tag with the name and address of the consignee is on file in the office of the Nursery Inspector at Gainesville, Florida.

The use of this certificate tag upon nursery stock which has not been inspected by a duly appointed nursery inspector of the Plant Board is a violation of the law and will be prosecuted.

Approved:

....
Plant Commissioner. Nursery Inspector.

The reverse side of the above tag to read as follows:

"Important. Read Carefully.

"This shipment is from a nursery located in Scaly Bark territory. It may be moved to any point in the following defined areas*: Pinellas County; the area bounded on the east by the Indian River, on the west by the St. Johns River, on the north by the northern boundary of the town of Cocoa and on the south by the southern boundary of the town of Bonaventure; the area bounded on the east by the Banana River, on the west by the Indian River, on the north by Banana Creek, and on the south by the southern boundary of the town of Georgiana (meaning Fairyland Grove); the area extending three miles in all directions from the Station of Knights in Hillsboro County, and the property of the Allapatahatchee Fruit and Vegetable Co., occupying the E½ of the NE¼, the SW¼ of the NE¼, the S½ of the NW¼ of the NE¼, and the N½ of the SE¼ of Sec. 27, Township 35 South, Range 39 East. It will be a violation of the law to plant these trees in any other section of the State. *Railroad and express agents* shall not accept shipments bearing this tag for points not located in the above-named areas."

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* For description of Scaly Bark areas as at present defined, see amended Public Notice on page 148.

The words "SCALY BARK" shall be printed in red letters directly over the wording on both sides of this tag.

FORM NO. 5 (Serial Number)

FLORIDA STATE PLANT BOARD
Office of Plant Commissioner,
Gainesville, Fla.

PORT AND RAILWAY INSPECTION CERTIFICATE

................................, Fla., ..., 19.......

This is to certify that the undersigned has this day inspected the contents of this package from.., ...

consigned to.., State of..,
and has found them apparently free from especially injurious insects, pests and diseases. No plants or plant products were found therein, the importation of which is prohibited by the Rules of the State Plant Board of Florida under the Florida Plant Act of 1915.

All persons are warned, under penalty of the law, not to use this certificate tag upon any shipment, or upon any plants or plant products, other than those described and inspected as above.

Authorized:

....
Plant Commissioner. Deputy Port and Railway Inspector.

Rule 7.* Any person affected by any rule or regulation made or notice given pursuant to the Florida Plant Act of 1915, may have a review thereof, for the purpose of having such rule, regulation or notice modified, suspended or withdrawn, by filing a written request with the Chairman of the State Plant Board, stating the particular rule, regulation or notice regarding which action is desired and setting forth the objections to the enforcement of said rule, regulation or notice.

At the time of filing said written request the person asking for such review shall deposit a certified check for one hundred and fifty dollars ($150) with the Chairman of the Board or, in case the destruction of property is involved, with the agent of the Board responsible for the carrying out of the provisions of the Florida Plant Act of 1915 in the locality in which the property affected is located. Said sum of $150 is to be applied towards defraying the expenses of a special meeting of the Board, providing the Chairman considers the exigencies of the case require action before the next regular meeting.

In case such special meeting is called the Secretary of the Board shall present an account of the expenses incurred for holding said meeting and if these expenses are less than $150 the balance shall be returned to the person requesting the review.

On such review all facts and representations offered on behalf of the applicant or on behalf of the Board may be presented to the Board in the form of affidavits.

The operation or enforcement of any rule or regulation made or notice given by the Board is not to be held in abeyance pending a review thereof but is to remain in full force and effect until modified, suspended or withdrawn by action of the Board. Providing that where the enforcement of a rule requires the destruction of the property of the party making the appeal to the Board in the manner aforesaid and the said sum of $150 to cover costs having been deposited with an agent of the Board, such destruction shall be suspended until the party shall have had the opportunity of being heard on his appeal; provided that the party thus appealing complies with the instructions of the agent of the Board to the end that no especially injurious insect pest or disease shall be disseminated.

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* Adopted June 19,1915.

Rule 8.† The planting, cultivating or harvesting of any truck or field crop in a grove or nursery which is, has been, or shall become infected with citrus canker, is hereby prohibited until such time as the Plant Commissioner may deem such procedure unlikely to spread citrus canker.

Rule 9.* Hereafter, work in properties infected with citrus canker shall be carried on by the owner or his employees, under the general supervision of agents of the Plant Board, appointed especially for this purpose. Said agents shall have authority such that in case the work in infected properties is being carried on in such manner as to make likely the spread or dissemination of citrus canker, whether within the affected property or other properties, they may so restrict the manner of carrying on such work as to prevent as far as possible the spread of the disease.

Rule 10‡. The harvesting of citrus fruits from any grove which is, has been or shall become infected with citrus canker is hereby prohibited except when such harvesting shall be carried on under the immediate supervision of an agent of the Plant Board whose wages shall be paid by the owner of the fruit, at the time it is picked. Said agent of the Board shall be authorized to prescribe such precautions in connection with the harvesting of such fruit and the hauling or otherwise moving thereof as shall, as far as possible, render unlikely the fruther dissemination of citrus canker.

The packing of citrus fruit from such an infected property shall be carried on only under the immediate supervision of an agent of the Board whose wages shall be paid by the person operating the packing house at which the fruit is prepared for shipment, or in case such fruit is not prepared for shipment in a packing house, by the person owning the fruit at the time it is packed. Said agent shall be authorized to prescribe such precautions in connection with the packing and otherwise handling of such fruit for shipment as shall, as far as possible, render unlikely the further dissemination of citrus canker.

The shipment of citrus fruit consigned to any point in the State of Florida from such an infected grove or from any packing house in which the fruit from such an infected grove has been prepared for shipment, is hereby prohibited.

The shipment of citrus fruit in bulk or otherwise than wrapped and packed in standard crates from such infected property or from any packing house in which fruit from an infected property is prepared for shipment is hereby prohibited, and the acceptance thereof for transportation by a common carrier is likewise prohibited.

Provided that this rule shall not apply to such properties as have been declared by the Board as no longer infected with citrus canker.

Rule 11A§. The shipment, transportation or carrying of any and all citrus fruits, either by common carriers, dining or buffet cars, railway news companies or individuals, into the State of Florida from the States of Georgia, Alabama, Mississippi, Louisiana or Texas, which states have considerable areas infected with citrus canker, is hereby prohibited.

Rule 11B§. The shipment, transportation or carrying of any and all citrus fruits, either by common carriers, dining or buffet cars, railway news companies, or individuals into the State of Florida from the State of California, is hereby prohibited on account of the prevalence in that state of the disease known as the Brown Rot of lemons and oranges *(Pythiacystis citrophthora)*.

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* Adopted July 12, 1915.

† Adopted July 12, 1915.

‡ Adopted August 9, 1915.

§ Adopted Aug. 9, 1915. Amended Dec. 13, 1915, Apr. 10, 1916, May 8, 1916, and Oct. 13, 1916.

Rule 11C.[*] The importation of citrus fruits, sapodillas *(Achras sapotes)*, guavas, mangoes, peaches and plums into the State of Florida from Mexico, in which country the Morelos fruit worm or orange maggot *(Anastrepha (Trypeta) ludens)*, is known to occur, is hereby prohibited and such importations arriving at any port, railway station or other place in the State of Florida, or found in the waters adjacent thereto, shall be subject to immediate confiscation by agents of the Plant Board.

Rule 11D.[*] The importation into the State of Florida of any and all fruits, vegetables, plants or parts of plants listed by the Plant Board as hosts of the Mediterranean fruit fly *(Ceratitis capitata)* from Africa (Cape Colonv, Congo, Delagoa, Dahomey, Nigeria, Transvaal and Uganda), Argentine Republic, Australia, Azores, Bermuda, Brazil, Cape Verde Islands, Europe (Italy, France, Malta, Spain and Sicily), Hawaiian Islands, Madeira and New Zealand, wherein the Mediterranean fruit fly is known to exist, is hereby prohibited and such importations arriving at any station, port or other place within the State of Florida, or found in the waters adjacent thereto, shall be subject to immediate confiscation by agents of the Plant Board, excepting that the following plant products may be admitted in the form herewith specified from the countries above-listed as being those in which the Mediterranean fruit fly is known to exist:

Coffee bean,
Figs (dried),
Grapes,
Lemons.

Rule 12[†]. On account of the danger of further spreading citrus canker the practice of using the leaves, twigs or branches of citrus trees and the products obtained therefrom for the purpose of disseminating the fungi used for the control of the white fly and citrus scale insects is hereby restricted to the use of such material as may be obtained from trees located outside the limits of any area declared by the Board to be dangerous on account of the prevalence of citrus canker therein and the picking, shipping or using of leaves, twigs or branches taken from trees located within such dangerous area is hereby prohibited.

Rule 13[†]. The owners, officers and employees of any nursery which may be found at any time to be infested or infected with any especially injurious insect pest or disease, or which has heretofore been so infested or infected, shall, on demand of the Plant Commissioner, furnish a list of all shipments and sales of nursery stock from said nursery from any date set bv the Plant Commissioner up to and including the date of such demand. Said list shall show the names and addresses of all purchasers, the names and addresses of all consignees and a complete description of the stock included in each and every shipment.

Rule 14[†]. The importation into the State of Florida of banana plants or bulbs and the importation of cocoanut trees, plants or nuts is hereby prohibited. Providing that this rule does not apply to the importation of cocoanuts with the husks removed and not to be used for planting.

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[*] Adopted Aug. 9, 1915. Amended Dec. 13, 1915, Apr. 10, 1916, May 8, 1916, and Oct. 13, 1916.

[†] Adopted Sept. 13, 1915.

PUBLIC NOTICE

Declaring Certain Areas Infected With the Disease Known as Scaly Bark

The following Public Notice regarding the existence of Scaly Bark in certain areas, adopted by the State Plant Board at its meeting held in Gainesville, Fla., March 12, 1917, supersedes the public notices on the same subject which were published on pages 24 and 25 of Circular No. 10, page 9 of Circular No. 11, page 1 of Circular No. 14 and page 5 of Circular 16 and embraces certain additional territory:

" Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board in session at Gainesville, Florida, this 12th day of March, 1917, and in accordance with Section 12 of said Act, does declare the disease known as Scaly Bark *(Cladosporium herbarum* var. *citricolum)* to be a disease, the dissemination of which should be controlled, and hereby declares and gives public notice that the following areas are areas in which citrus trees are likely to be infected with said disease:

" Pinellas County; Merritts Island and a belt of land two miles wide in Brevard County bounded on the south by the southern boundary of Township 26 South, on the east by the Indian River and on the north by the County line, and Sections 2, 3, 4, 13, 14 and 24 in Township 20 South, Range 35 East and Section 19 in Township 20 South, Range 36 East; Townships 14 and 15 South in Range 32 East, Townships 15, 16 and 17 South in Range 33 East, Townships 17 and 19 South in Range 34 East; Township 19 South in Range 35 East and the N½ of Township 18 South in Range 34 East in Volusia County; Townships 28 and 29 South in Range 20 East, Townships 28 and 29 South in Range 21 East, Township 28 South in Range 22 East and Township 29 South in Range 19 East in Hillsboro County; Sections 21 and 22, Township 24 South, Range 16 East, near Hudson, Pasco County; Sections 16 and 17, Township 34 South, Range 25 East, near Wauchula, and Sections 17, 18, 19 and 20 in Township 33 South, Range 24 East, near Fort Green Springs, and Sections 8 and 17 in Township 36 South, Range 33 East, and Sections 1, 2 and 3 in Township 36 South, Range 32 East, and Sections 34, 35 and 36 in Township 35 South, Range 32 East, near Fort Bassenger, and Sections 28, 32 and 33 in Township 38 South, Range 24 East, near Nocatee, DeSoto County; that portion of Lake County bounded on the north by Dead River and Lake Harris, on the west and south by Lake Harris and on the east by the eastern boundary line of Range 25 East, and Sections 7, 8, 17, 18, 19 and 20 in Township 19 South, Range 27 East and Sections 13, 23 and 24 in Township 19 South, Range 26 East, near Eustis, Lake County; Township 21 South, Range 31 East, and that portion of Township 20 South, Range 31 East which is south and east of Lake Jessup, Seminole County; Sections 1 and 2, Township 22 South, Range 30 East, near Golden Rod, Orange County; Section 23, Township 25 South, Range 29 East, Section 4, Township 26 South, Range 30 East and Oliver's Island in Lake Tohopekaliga, and Sections 30 and 31 in Township 35 South, Range 33 East, near Bassenger, Osceola County; Sections 8, 9, 23, 24, 25 and 26 in Township 23 South, Range 19 East, and Sections 15, 16, 21, 22, 32 and 33 in Township 23 South, Range 20 East, near Brooksville, Hernando County; and the property of the Allapatahatchee Fruit and Vegetable Company, occupying the E½ of the NE¼, the SW¼ of the NE¼, the S½ of the NW¼ of the NE¼, and the N½ of the SE¼ of Section 27, Township 35 South, Range 39 East in St. Lucie County, State of Florida."

The following shipping points are located within the Scaly Bark territory defined above:

Allendale §
Allenhurst *
Anclote ‡
Anona ‡
Antioch †
Artesia *
Aurantia *
Banyan *
Bassenger ‡‡
Bayview ‡
Belleair ‡
Belleview Hotel ‡
Boca Ceiga ‡
Bonaventure *
Bowles §
Brandon †
Brantley *
Briggsville §
Canaveral *
City Point *
Clearwater ‡
Clifton *
Clifton §§
Cocoa *

Coronado §
Courtenay *
Cross Bayou ‡
Daytona §
Daytona Beach §
Delespine *
Dover †
Dunedin ‡
Durant †
East Cove †
Footman *
Frontenac *
Fulton's Spur †
Ft. Bassenger ††
Ft. Green Springs ††
Ft. Green ††
Gabriella ‖
Garret †
Gary †
Georgiana *
Glencoe §
Glenoak ‡
Golden Rod ‖
Green Springs ‡
Gulfport ‡
Hardee †
Hawks Park §
Hillsboro †
Holly Hill §
Hucomer §
Idlewild Park †
Indianola *
Indian River City *
Indian Rock ‡
Johns Pass ‡
Keystone Colony ‡
Kimbrough ‡
Kingston §
Knights †
LaGrange *
Lake Charm §§
Lake Villa Junction ‡
Lane Park **
Largo ‡
Lellman ‡
Limona †
Lotus *
Lyrata *
Mango †
Maytown §
Merritt *
Mims *
Mortonhurst *
New Smyrna §
Nocatee ††
Oak Hill §
Oak Hurst ‡
Oceanus *
Orient †
Ormond §
Ormond Beach §
Oviedo §§
Ozona ‡
Pineda *
Pinellas ‡
Pinellas Park ‡
Plant City †
Ponce Park §
Port Orange §
Rockledge *
Safety Harbor ‡
Saint Petersburg ‡
Seabreeze §
Seaside ‡
Seffner †
Seminole Beach ‡
Seminole ‡
Sharpes *
Shiloh *
Sidney †
Sutherland ‡
Taconey ‡
Tampa †
Tarpon Springs ‡
Thonotosassa †
Thonotosassa Junction †
Titusville *
Tropic *
Turkey Creek †
Turnbull *
Valrico †
Veteran ‡
Wall Springs ‡
Wiley Ave. *
Wilson *
Ybor City †
Youmans †

* In Brevard County
† In Hillsboro County
** In Lake County
‡ In Pinellas County
§ In Volusia County
§§ In Seminole County
†† In DeSoto County
‖ In Orange County
‡‡ In Osceola County

Rule 15.* The movement of citrus trees, or parts thereof, from the areas designated in the Public Notices by the State Plant Board as areas in which citrus trees are likely to be infected with Scaly Bark, into all parts of the State of Florida other than those specified as infected areas, is hereby prohibited.

This rule shall not apply to the movement of citrus fruits that are intended as food products.

Rule 16.† Every grove, field, nursery or other property in which has been found any disease or insect pest which has been declared a public nuisance by the State Plant Board under the provisions of the Plant Act of 1915, shall be conspicuously posted with signs warning all parties against trespassing, said signs to read as follows: " No Trespassing. By Order of The State Plant Board." The words " NO TRESPASSING " to be in letters no less than four inches in height and the words " State Plant Board " to be in letters not less than two and one-half inches in height, such letters to be of prominent bold-faced type, easily read. The mutilation, defacing, removing or destroying of such signs by any parties whomsoever is hereby prohibited. Provided that the posting of such notices shall not be required in the case of any property which has been declared by the State Plant Board to be no longer a danger center.

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* Adopted Oct. 11, 1915.
† Adopted Nov. 8, 1915. Amended Feb. 14, 1916.

Rule 17*. The introduction into the State of Florida through the ports thereof of plants, fruits, vegetables or other material that is likely to introduce insect pests or diseases especially injurious to the agricultural and horticultural interests of the State is hereby prohibited; provided, however, that plants, parts of plants, fruits or vegetables, the importation of which into the State has not been specifically prohibited, and which shall be found upon inspection by a properly appointed agent of the Plant Board to be apparently free from such especially injurious insect pests and diseases shall be permitted to enter the State and be transported, sold, or exchanged within the State.

Rule 18†. To prevent the introduction of the cotton boll weevil into the non-infested territory in the State of Florida, from any region in Florida or from other states or territories in which the boll weevil is known to exist, the shipment or transportation of the following articles from boll weevil infested territory, into non-infested territory in the State of Florida, is hereby prohibited: Seed cotton, cotton, cotton seed, cotton seed hulls, seed cotton sacks (used), cotton picker's sacks (used), Spanish moss, corn in shuck, living boll weevils in any stage, cotton plants or parts of cotton plants (baled cotton, cotton seed meal, cotton seed cake and cotton seed oil excepted) and shipments of household goods or other commodities containing any of the foregoing; provided, that this restriction shall not apply to shipments of cotton seed hulls between January 1st and August 1st of each year, or to corn in shuck between July 1st and September 30th of each year; and provided, further, that shipments of cotton seed for planting purposes may be made when such shipments are accompanied by the certificate of a State or Government entomologist stating that such seed has been fumigated in a manner to kill any boll weevils that may be contained therein; and provided, further, that permits may be issued by the Plant Commissioner for shipment of cotton seed hulls into the non-infested section of Florida, from cotton oil mills located in the boll weevil infested territory under such precautions and safeguards as to milling, packing, handling and shipping as he may specify.

Shipments of household goods originating in any boll weevil infested territory of the State of Florida, or in any other state or territory, when shipped into the non-infested portion of Florida, shall be accompanied by an affidavit showing that said shipments do not contain any of the articles above listed and the shipment of which into the non-infested portion of Florida is prohibited.

The keeping or having in possession of any living boll weevils, or any eggs, living larvae, or living pupae of said insect, in the non-infested portion of the State of Florida, is hereby prohibited.

The Plant Commissioner shall, from time to time, publish and define the territory in the State of Florida which is considered to be boll weevil infested territory and which is defined as such within the meaning of this regulation.

All rules and regulations of the Plant Board in conflict with this rule are hereby rescinded.

BOLL WEEVIL INFESTED TERRITORY IN FLORIDA—DEFINED.

In accordance with Rule No. 18, adopted by the State Plant Board of Florida December 13, 1915, and amended November 13, 1916, the Plant Commissioner has defined, and does hereby define, as a result of actual inspections made by agents of the State Plant Board, the Counties of Nassau, Duval, Clay, Bradford, Alachua and Levy and all counties west and north thereof, in the State of Florida, as being boll weevil infested territory within the meaning of said Rule.

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* Adopted Nov. 8, 1915. Amended Dec. 13, 1915.
† Adopted Dec. 13, 1915. Amended Nov. 13, 1916.

PUBLIC NOTICE *

Declaring Certain Areas to Be Infected With Withertip

Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board, in session at Jacksonville, Florida, this 14th day of February, 1916, and in accordance with Section 12 of said Act, does declare the disease known as Withertip *(Colletotrichum gloesporiodes)* to be a disease, the dissemination of which should be controlled, and hereby declares, that while this disease is generally distributed throughout the State, the following areas are areas in which this disease is not known to exist; the area bounded on the south by the waters of the Bay of Florida, on the west by the Gulf of Mexico, on the north by White Water Bay and its tributaries, and on the east by the eastern boundary-line of Monroe County.

Rule 19*. The movement of citrus trees, or parts thereof, into the areas designated in the public notices by the State Plant Board, as areas in which withertip is not known to exist, is hereby prohibited.

This rule shall not apply to the movement of citrus seed under package certificate issued by a duly appointed inspector of the Plant Board.

Rule 20*. Any and all plants or plant products subject to the provisions of the Florida Plant Act of 1915, whether in transit or in the hands of possessor, may be held for inspection regardless of whether they are certified or not, and if such plants or plant products are found to have been moved or transported in violation of the rules or regulations of the Plant Board, or if found infested or infected with any injurious insect pest or disease, such plants or plant products must be deported, sprayed or otherwise treated upon the order of the Plant Commissioner, if in his opinion this is necessary for the protection of the agricultural or horticultural interests of the State.

Rule 21†. The sale, gift, exchange, shipment or movement of trees, plants or plant products infested or infected with any of the insects or diseases listed by the Board in accordance with Section 12 of the Florida Plant Act of 1915, is hereby prohibited, except when specifically authorized by the Plant Commissioner or his duly authorized representative. This rule shall not apply to the movement of plant products that are intended as food products unless in the opinion of the Plant Commissioner such shipment will be dangerous to the agricultural and horticultural interests of the State.

Rule 22*. The movement of nursery stock from a nursery in which Cottony Cushion Scale is known to have been present or from a section in which Cottony Cushion Scale is known to have been generally distributed, except when treated as required by the Nursery Inspector, is hereby prohibited.

Rule 23‡. Any person or firm desiring to ship nursery stock into Florida shall file with the Nursery Inspector a satisfactory certificate of inspection. They will then be privileged to purchase Permit Certificate tags from the Florida Nursery Inspector. One, and only one, Permit Certificate tag shall be attached to each bundle of nursery stock shipped into Florida. Shipments shall be prepared and tags accounted for in accordance with the requirements of the Nursery Inspection Department of the State Plant Board of Florida.

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* Adopted February 14, 1916.
† Adopted February 14, 1916. Amended March 13, 1916.
† Adopted February 14, 1916. Amended March 13, 1916.
‡ Adopted April 10, 1916.

Rule 24*. Persons or firms desiring certification of nursery stock shall file a request for inspection with the Nursery Inspector at Gainesville, at least sixty days in advance of the date upon which they desire to move or sell such nursery stock. Persons or firms requesting certification on shorter notice may be charged with the fee covering the expenses of inspection and certification as provided for in Section 9 of the Florida Plant Act of 1915.

Rule 25*. In order to prevent the introduction of the citrus disease known as citrus canker, the importation into Florida, of any and all kinds of citrus trees and parts thereof, including budwood and scions, and all other host plants of this disease as soon as discovered, except certain fruit intended for use as food products, is hereby prohibited. Provided, that importations of limited quantities of new or rare varieties may be allowed by special permit of the Plant Commissioner. Applications for such permits must be made to the Plant Commissioner, Gainesville, Florida.

Rule 26†. The importation into Florida of all trees, plants, vines, shrubs, cuttings, scions, leaves and parts of plants from The Bahamas, India and Jamaica, in which countries the spiny citrus white fly *(Aleurocanthus woglumi)* is known to occur, is hereby prohibited: provided, that this rule shall not be construed as prohibiting the importation of fruits and vegetables intended for use as food products when such fruits or vegetables are not infested or infected with any injurious insect or disease or the importation of which is not otherwise specifically prohibited: and provided, further, that this rule shall not prohibit the importation of lumber, logs, sisal hemp or manufactured articles.

Rule 27‡. The importation into the State of Florida of any and all of the following plants, plant products and stone and quarry products, originating in that portion of the New England states defined by the United States Department of Agriculture as being territory infested with the gypsy moth *(Porthetria dispar)*, is hereby prohibited, except that shipments of the things or articles herein enumerated may be admitted and permitted delivery in this State when accompanied by an inspection certificate (or permit) issued by a properly authorized agent of the United States Department of Agriculture or by the proper inspection official of the State in which such shipments originate, showing that they have been inspected and found free from the gypsy moth and the larvæ, pupæ and eggs thereof, and plainly labelled with the names and addresses of both consignor and consignee;

All trees, plants, shrubs, vines, cuttings, grafts, buds, and all other trees and plants, or parts thereof, commonly known as nursery stock.

All forest, fruit and ornamental trees and shrubs and parts thereof.

Field-grown florists stock, shrubs, vines, and all other plants or parts thereof for planting or propagation, except flower or vegetable seeds.

Forest-plant products, including logs, tan bark, posts, poles, railroad ties, cordwood, lumber, box-bands, and hoops.

Coniferous trees, such as spruce, fir, hemlock, pine, juniper, cedar and arbor vitæ, known and described as Christmas trees, and parts thereof.

Decorative plants, such as holly and laurel, known and described as Christmas greens or greenery.

Stone and all other quarry products.

Shipments of any of the articles aforesaid, originating at any point within the area defined by the United States Department of Agriculture as being infested by the gypsy moth, arriving at any port or other destination in the State of Florida without being accompanied by the certificate of inspection herein required, shall be subject to immediate deportation upon the order of the Plant Commissioner or his assistants, or otherwise treated as the Plant Commissioner may direct.

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* Adopted April 10, 1916.
† Adopted June 5, 1916.
‡ Adopted Oct. 13, 1916.

Rule 28[*]. The importation into the State of Florida of pineapple plants, slips, roots, fruits and all parts thereof, from Jamaica, in which country the Pineapple Black Weevil *(Metamasius ritchiei)* is known to exist, is hereby prohibited: provided, that this rule shall not prohibit the importation from Jamaica of canned pineapple or of processed pineapple juice.

Rule 29[*]. The movement of nursery stock from a nursery in which the Dictyospermum scale is known to have been present or from a section in which the Dictyospermum scale is known to exist except when treated as required by the Nursery Inspector is hereby prohibited.

Rule 30[†]. Whenever any authorized Inspector of the State Plant Board shall find in the possession of any common carrier in this State any shipment, article or product that is infected or infested with any insect, pest or disease, the dissemination of which, under the law or rules of this Board, now or hereafter promulgated, is or shall be prohibited, such common carrier shall make no further transportation or delivery of such shipment, article or product so infected or infested, otherwise than to return the same to the shipper, to be by him dealt with or treated as the law may provide. At the time of such inspection such inspector shall deliver to such common carrier a certificate in substantially the following form:

"To...and All Whom It May Concern:
(Name of carrier)

"This is to certify that on the................day of................................
19........, the undersigned inspected while in your possession at
....................................., Florida, a shipment of.....................................,
(Kind and nature)
consisting of..bundles or packages, shipped by
.... of ....,
State of..., to..., at
...., State of Florida, and found the same to
be infected or infested with...
(Name of insect pest or disease)

"And you are hereby notified that the transportation and delivery of said shipment so infected or infested, within the State of Florida, is prohibited by law and the Rules of the State Plant Board thereunder, except for the purpose of returning said shipment to the shipper, to be by him dealt with or treated as the law may require.

"This......................day of..., 19........
....
State Plant Board Inspector."

That the said Inspector shall at the same time attach to such shipment a duplicate of said Certificate.

It shall also be the duty of said Inspector to forthwith notify the consignee and consignor, if their names and addresses be known to such inspector, which notice shall contain in substance the information provided for in the foregoing form of certificate.

Rule 31[‡]. All inspectors employed by the State Plant Board shall be required to pass a written examination and to present satisfactory evidences of previous experience qualifying them for the particular duties for which they are employed.

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[*] Adopted Jan. 8, 1917.
[†] Adopted Feb. 12, 1917.
[‡] Adopted April 9, 1917.

ORDERS AND REGULATIONS OF THE POSTOFFICE DEPARTMENT
RELATIVE TO PARCEL POST SHIPMENTS OF NURSERY STOCK AND CERTAIN OTHER PLANTS AND PLANT PRODUCTS

Nursery Stock—Not Admitted to Mails Unless Accompanied by Certificate of Inspection

Paragraph 2 of Section 478 of the Postal Laws and Regulations reads as follows:

> "Nursery stock, including all field-grown florists' stock, trees, shrubs, vines, cuttings, grafts, scions, buds, fruit pits and other seeds of fruit and ornamental trees or shrubs, and other plants and plant products for propagation, except field, vegetable, and flower seeds, bedding plants, and other herbaceous plants, bulbs, and roots, may be admitted to the mails only when accompanied by a certificate from a State or Government inspector to the effect that the nursery from which such nursery stock is shipped has been inspected within a year and found free from injurious insects, and the parcel containing such nursery stock is plainly marked to show the nature of the contents and the name and address of the sender."

Terminal Inspection of Plants and Plant Products Addressed to Florida Postoffices

The following Order was issued by W. J. Barrows, Act'g Third Asst. P. M. General, under date of October 24, 1916:

> "OFFICE OF THIRD ASS'T P. M. GENERAL,
> WASHINGTON, OCT. 24, 1916.
>
> "The State of Florida has established a place for the terminal inspection of plants and plant products under the provisions of the Act of March 4, 1915, embodied in Section 478¼, Postal Laws and Regulations, appearing on page 49 of the May, 1915, Supplement to the Postal Guide.
>
> "All postmasters are, therefore, informed that packages containing plants or plant products addressed to places in the State of Florida may be accepted for mailing only when plainly marked so that the contents may be readily ascertained by an inspection of the outside thereof. The law makes the failure so to mark such parcels an offense punishable by a fine of not more than $100.
>
> "The plants and plant products subject to terminal inspection in the State of Florida are described as follows:
>
> "'All trees, plants, shrubs, vines, cuttings, grafts, scions, buds, leaves, roots, fruit pits, and all other seeds of forest, fruit or ornamental trees or shrubs; all greenhouse, herbaceous and bedding plants and parts thereof; all blossoms or flowers of orange, lemon and other citrus plants; all fruits or nuts; all herbarium or dried specimens of plants or parts thereof, and other plants and plant products in the raw or unmanufactured state, except vegetable and flower seeds. *Provided,* That this list of plants and plant products shall not apply to plants and plant products shipped under the certificate of the Federal Horticultural Board of the U. S. Department of Agriculture, nor to plants and plant products originating in Florida and addressed to places in that State which are inclosed in packages plainly marked to show the nature of the contents and accompanied with the certificate from the Florida State Plant Board or its duly authorized inspectors embodying the information prescribed by paragraph 2, Section 478, Postal Laws and Regulations.'
>
> "Postmasters within the State of Florida shall be governed strictly by the provisions of paragraphs 3, 4, 5, and 6, Section 478¼,

Postal Laws and Regulations, in the treatment of all packages addressed for delivery at their offices containing any plants or plant products above described as subject to terminal inspection.

"Inspection service is maintained at Gainesville, Fla., and all postmasters in that State shall send to that place for inspection after receiving the required postage therefor, under the provisions of Section 478¼, Postal Laws and Regulations, each package containing plants or plant products subject to terminal inspection.

"Owing to the perishable character of plants and plant products, the packages containing such matter must be given prompt attention.

"Any failure of compliance with the foregoing instructions or with the provisions of Section 478¼, Postal Laws and Regulations, coming to the attention of any postmaster should be reported to the Third Assistant Postmaster General, Division of Classification.

"W. J. Barrows,
"Act'g Third Ass't P. M. Gen."

Section 478¼ P. L. & R.

Section 478¼ of the Postal Laws and Regulations, under authority of which the above Order is issued, and which is referred to therein, reads as follows:

> "Sec. 478¼. *(a)* When any State shall provide for terminal inspection of plants and plant products, and shall establish and maintain, at the sole expense of the State, such inspection at one or more places therein, the proper officials of said State may submit to the Secretary of Agriculture a list of plants and plant products and the plant pests transmitted thereby, that in the opinion of said officials should be subject to terminal inspection in order to prevent the introduction or disseminaion in said State of pests injurious to agriculture. Upon his approval of said list, in whole or in part, the Secretary of Agriculture shall transmit the same to the Postmaster General, and thereafter all packages containing any plants or plant products named in said approved lists shall, upon payment of postage therefor, be forwarded by the postmaster at the destination of said package to the proper State official at the nearest place where inspection is maintained. If the plant or plant products are found upon inspection to be free from injurious pests, or if infected shall be disinfected by said official, they shall upon payment of postage therefor be returned to the postmaster at the place of inspection to be forwarded to the person to whom they are addressed; but if found to be infected with injurious pests and incapable of satisfactory disinfection the State inspector shall so notify the postmaster at the place of inspection, who shall promptly notify the sender of said plants or plant products that they will be returned to him upon his request and at his expense, or in default of such request that they will be turned over to the State authorities for destruction. (Act of March 4, 1915.)
>
> "*(b)* It shall be unlawful for any person, firm, or corporation to deposit in the United States mails any package containing any plant or plant product addressed to any place within a State maintaining inspection thereof, as herein defined, without plainly marking the package so that its contents may be readily ascertained by an inspection of the outside thereof. Whoever shall fail to so mark said packages shall be punished by a fine of not more than $100. (Act of March 4, 1915.)
>
> "*(c)* The Postmaster General is hereby authorized and directed to make all needful rules and regulations for carrying out the purposes hereof. (Act of March 4, 1915.)
>
> "2. When the Secretary of Agriculture furnishes the Postmaster General a list of plants and plant products subject to ter-

minal inspection under the provisions of the preceding paragraph, appropriate instructions in regard thereto shall be issued to postmasters by the Third Assistant Postmaster General, Division of Classification.

"3. When a package containing plants or plant products subject to terminal inspection is received at the post office of address, the postmaster shall at once notify the addressee of the required amount of postage for forwarding it to the place of inspection and return. Upon payment of the required amount, the postmaster shall affix to the parcel stamps sufficient to cover the postage from his office to the place of inspection, and place in an official envelope, to be attached to the parcel and addressed to the postmaster at the place of inspection, the stamps representing the amount of postage furnished by the addressee for its return. The postmaster shall then indorse on the wrapper of the parcel the words, "Forward to ...., for inspection," and transmit
(Give postoffice of inspection)
the parcel to the postmaster at the place of inspection.

"4. *(a)* On receipt of the parcel at the post office of inspection the postmaster shall deliver it to the proper State official, and if such official shall return it to him marked to show that it has been inspected and passed, the postmaster shall affix to the parcel the postage furnished for returning it to the post office of address and promptly transmit it to that office. It shall then be delivered to the addressee.

"*(b)* If the State official to whom a parcel containing plants or plant products has been sent for inspection shall inform the postmaster at the place of inspection that such plants or plant products are infected with injurious pests and incapable of satisfactory disinfection, the postmaster shall promptly notify the sender that the parcel is undeliverable, giving the reason therefor together with the name and address of the addressee, and stating the amount of postage required for its return and that if the postage is not promptly furnished the parcel will be turned over to the State authorities for destruction. After the sending of such notice, the postmaster shall wait the length of time prescribed in paragraph 8, Section 637, when, if postage be not received by that time, he shall inform the State authorities that the parcel may be destroyed by them.

"5. When a parcel containing plants or plant products is returned to the sender or destroyed under the provisions of the preceding paragraph, the postage stamps representing the amount of postage furnished by the addressee for the return of such parcel from the post office of inspection to the office of address shall be sent by the postmaster at the former office to the addressee together with a letter of information as to the disposition of the parcel.

"6. If the addressee, after having been notified, as prescribed in paragraph 3 of this section, fails to furnish the required postage for sending the parcel to the place of inspection and return, the postmaster shall so notify the State Inspector at that place and advise him of the amount of postage required for sending the parcel to him. If such official furnishes the postage the postmaster shall, after affixing the necessary stamps, indorse on the wrapper of the parcel the words 'Forward to..
(Give postoffice of inspection)
for inspection,' together with the words 'Postage paid by State,' and transmit it to the postmaster at the place of inspection. If the State Inspector shall return the parcel to the postmaster at the point of inspection, marked to show that it has been inspected and passed, and having postage properly prepaid, it shall be transmitted to the office of address and delivered to addressee. Should the State Inspector fail to furnish the postage for sending the parcel to him

for inspection, the parcel shall be treated as other undeliverable fourth-class matter, as prescribed in Section 637."

Summary

Under the provisions of the foregoing Order of the Third Asst. P. M. General, and under the sections of the Postal Laws and Regulations referred to:

All packages of plants and plant products tendered for mailing to points in Florida must be plainly labelled to show the nature of the contents.

A list of the various plants and plant products subject to inspection is given in the Order quoted above.

Parcel-post packages of plants and plant products, originating in Florida, bearing the inspection certificate tag of *the State Plant Board of Florida,* when addressed to Florida points, may be sent direct to addressee: namely; such packages do not have to be sent to the postoffice at Gainesville, Florida, for inspection.

Parcel-post packages of plants and plant products, regardless of State of origin, bearing the inspection certificate of *the Federal Horticultural Board,* U. S. Dept. of Agriculture, may also be sent direct to addressee.

Packages of plants or plant products (except vegetable and flower seeds), addressed to post offices in Florida, not accompanied by the inspection certificate of the Federal Horticultural Board, are required sent by the postmaster at office of address to the post office at Gainesville, Fla., for inspection by the State Plant Board, the postage thereon to be furnished by the addressee.

All packages of plants and plant products (except vegetable and flower seeds) from other States addressed to post offices in Florida, not accompanied by the inspection certificate of the Federal Horticultural Board, are required sent to the Gainesville post office for inspection.

An inspection certificate issued by the State officials of any State other than Florida does not entitle plants or plant products to delivery in Florida without being subjected to terminal inspection.

"Florida Permit Tags," accompanying mail shipments of plants or plant products, originating in another State, addressed to Florida post offices, do not exempt such shipments from the requirements of the Orders and Sections quoted above: namely, such shipments are subject to terminal inspection.

Mail shipments of plants and plant products, originating in Florida, but addressed to post offices in other States, are not required sent to the Gainesville post office for inspection. However, Paragraph 2 of Section 478, P. L. and R., quoted above, requires that all mail shipments of *nursery stock* (regardless of destination) shall have an official certificate of inspection attached when tendered for mailing.

Mail Shipments from Foreign Countries

> "A postoffice order dated May 27, 1913, as amended December 16, 1913, prohibits the importation by mail of all growing or living plants, seeds, and other plant products for propagation, except field, vegetable, and flower seeds."[*][†]

With reference to the treatment by postmasters of prohibited nursery stock received from foreign countries the Second Assistant Postmaster General issued the following Order under date of June 1, 1915:

> "This Department and the Department of Agriculture are in receipt frequently, both directly and through postmasters, of re-

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[*] U. S. Department of Agriculture, Federal Horticultural Board, Service and Regulatory Announcements, April 1916, page 46.

[†] Parties desiring to import plants from foreign countries, through channels other than the mails, should apply to the Federal Horticultural Board, Washington, D. C., for a permit under the Plant Quarantine Act of August 20, 1912, as amended March 4, 1913.

quests from importers of nursery stock that delivery be authorized of certain mail shipments of prohibited plants or plant products. It is understood that pending the receipt by such importers of replies to their requests, the shipments in question are withheld from return by postmasters notwithstanding the instructions of the Department that all packages of prohibited nursery stock received in the mails from abroad shall be appropriately indorsed and returned to origin immediately.

"Postmasters are enjoined, therefore, to comply strictly with the instructions referred to by declining to withhold from return any prohibited nursery stock in order to afford an opportunity to the importer to communicate with the Department with the view of having an exception made in any particular case.

"The term 'nursery stock' as applied to the prohibition in question includes all growing or living plants, seeds and other plant products, for propagation, except field, vegetable and flower seeds. It includes also bulbs, roots and tubers and, with the exceptions noted, the seeds of all trees, shrubs or other plants. The only plants or plant products excepted from the prohibition are those ordered by, or intended for, and addressed to the 'Office of Foreign Seed and Plant Introduction, United States Department of Agriculture, Washington, D. C.'

"In this connection, reference is had to the notice of this office printed on page 2 of the Postal Guide (supplement) for January, 1914, and to the notice on pages 129 and 130 of the Postal Guide for July, 1914.

"The widest possible publicity should be given to this notice."

The above information is published for the information of employees of the State Plant Board of Florida, nurserymen and other shippers of plants and plant products. Postmasters receive their instructions relative to the above from the Post Office Department.

WILMON NEWELL,
Plant Commissioner.

Gainesville, Fla.,
April 14, 1917.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. 1 JULY, 1917 No. 4

FLORIDA AND THE MEDITERRANEAN FRUIT FLY

By

E. A. BACK
Bureau of Entomology

With the passage of the Federal Plant Quarantine Act of 1912, there was made possible the first serious attempt in this country to prevent further introduction of insect and plant diseases from foreign countries. Along with the issuing of quarantines, the Federal Horticultural Board has been accumulating information regarding pests that will be injurious should they become established in the United States. Had such investigations been started years ago, Florida would now be free from such troubles as the citrus and the cloudy winged white flies *(D. citri* and *citrifolii)* and the citrus canker *(Pseudomonas citri)*, all of which could have been eliminated easily, either at the ports of entry, or in the quarantine greenhouses of the Department of Agriculture at Washington. With the efforts of

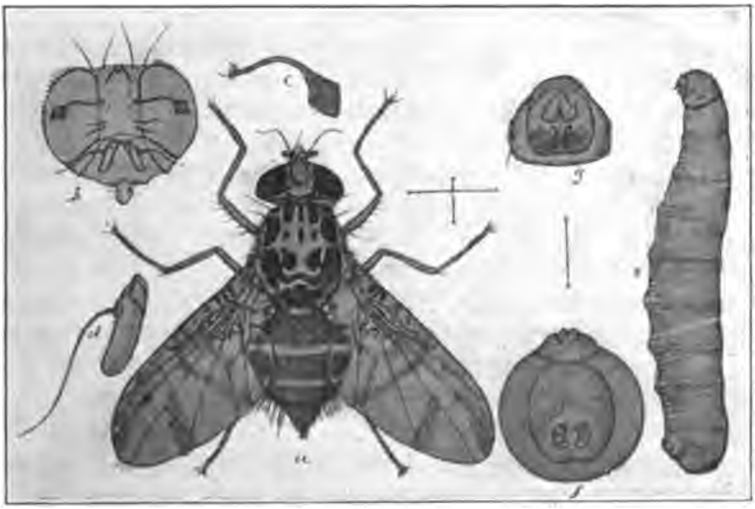

Fig. 3.—The Mediterranean fruit fly *(Ceratitis capitata)*: *a*, adult fly; *b*, head of same from front; *c*, spatula-like hair from face of male; *d*, antenna; *e*, larva; *f*, anal segment of same; *g*, head of same. *a* and *e*, enlarged; *b*, *g*, *f*, greatly enlarged; *c*, *d*, still more greatly enlarged. (From Howard, U. S. Dept. of Agriculture.)

the State Plant Board of Florida added to those of the Federal Horticultural Board, it is hoped that Florida will be kept free from the ravages of a number of well-known pests causing damage elsewhere. Among these pests is the Mediterranean fruit fly *(Ceratitis capitata)*, one of the worst enemies to fruits in general, that occurs in the tropical and semi-tropical countries, and one which will become established on the mainland of the United States in the not distant future unless quarantine officials are able to successfully intercept it.

WHAT IS THE FRUIT FLY LIKE?

The Mediterranean fruit fly is an insect which in the adult state resembles in size and general shape the ordinary house fly, but differs greatly in the color pattern of the body and wings, and in its habits. The colors, brown, yellow, black and white predominate in the living insect and form a pattern which can be easily recognized after comparison with the drawing of the adult fly given in Figure 3.

The female fly lays eggs in small cavities that she makes in the skin of fruits. These hatch into whitish maggots that burrow in all directions through the fruit until, when full grown, they are from 4 to 5 sixteenths of an inch long. (Fig. 3.) They then leave the fruit and form a pupa or chrysalis either in the soil or beneath any sheltering object. After passing a varying length of time in the pupal stage, the adult of the succeeding generation emerges. It is seldom that the adult fly is seen first. Usually the attention of the fruit grower is attracted to the decayed condition of his fruits, which, when cut open, are found to contain these whitish maggots that curl up and jump short distances when taken out of the fruit and placed upon a table. Maggots found in fruits which resemble the general description given—particularly as to size and the jumping habit—should be placed immediately in alcohol and sent with an explanatory letter to the State Plant Board at Gainesville so that an investigation to prevent a spread may be inaugurated without delay.

FRUITS AND VEGETABLES ATTACKED

The Mediterranean fruit fly is particularly injurious because it attacks many different kinds of fruits, nuts and vegetables. In the Hawaiian Islands, 72 kinds of fruits have been found infested. As the complete list will be available soon in bulletin form, it is not given here. It may be said, however, that almost any fruit in the Hawaiian Islands may harbor larvae of the

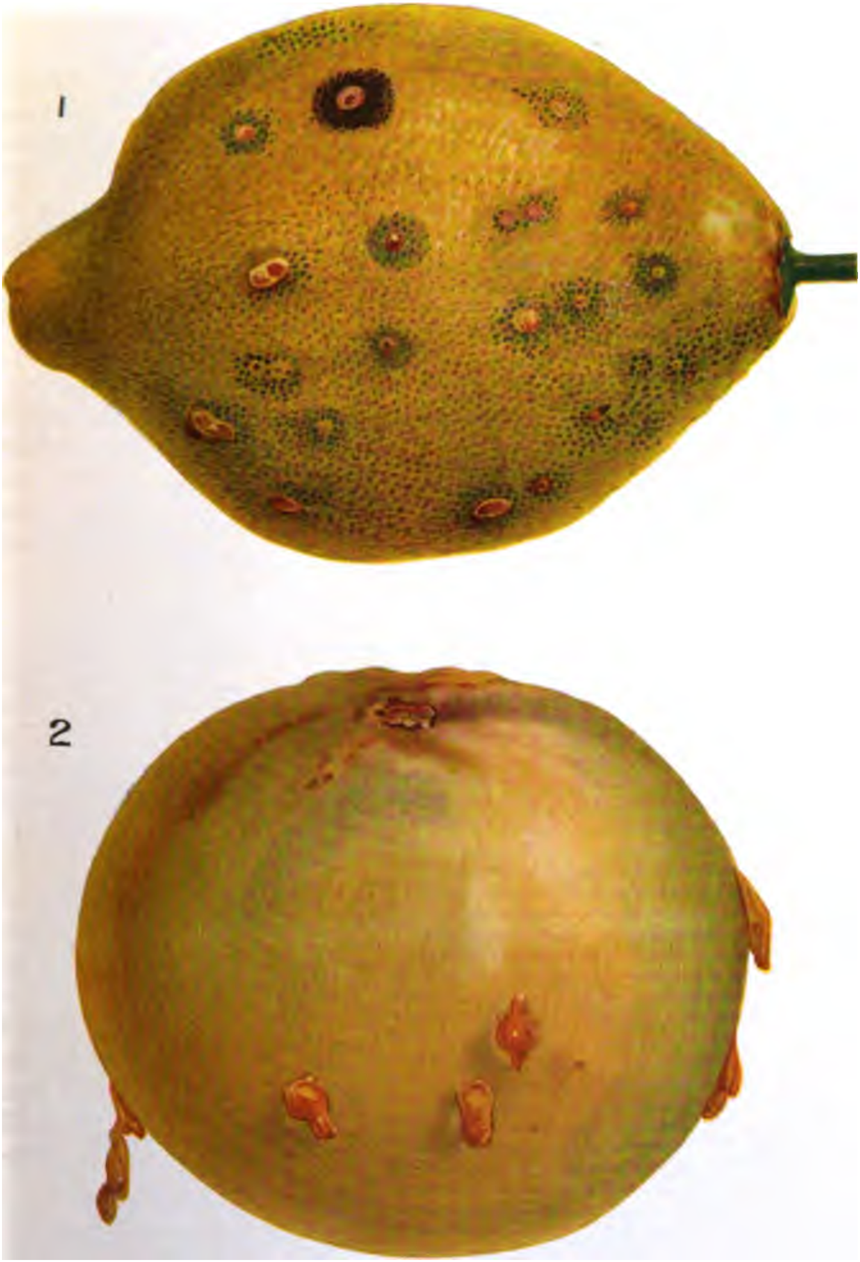

Plate XXIV.—Damage by Mediterranean Fruit Fly. 1, Hawaiian-grown lemon of commercial type. While discoloration does not always follow the puncturing of the rind, such disfigurations as shown are not unusual in Hawaii where infestation is excessive. Note the globules of gummy secretions accumulating about certain punctions; they may not occur, or they may take the form of slender spiral threads. Lemons may sometimes be infested in the rind without giving an external evidence to the student. 2, Ripe grapefruit, showing the copious gummy secretions that may, though more often do not, follow attack.

fruit fly, even though it be the nut of a palm, the berry of an ornamental shrub, or the edible fruit of some well-known commercial species. A partial list of host fruits contains oranges, grapefruit, lemons, limes, kumquats, tangerines, peaches, apples, figs, apricots, bananas, mangoes, avocadoes, sapotas, loquats, persimmons, guavas, quinces, papayas or pawpaws, pears, plums, grapes, eggplant, tomatoes, and even cotton bolls. Of these the eggplant, grapes, and cotton bolls are but slightly affected even under conditions most favorable to the fruit fly, and pawpaws and bananas become infested only if left upon the plants until they are very ripe. The berries of the umbrella or china-berry tree *(Melia azodarach)* and strawberries are not affected.

NORTH AMERICA ALONE FREE FROM INFESTATION

The Mediterranean fruit fly has been known to science for 100 years. During these years it has been spreading throughout the world until at present the North American continent is the only large land area upon which it has not become established. It first attracted serious attention in London where it was found that oranges arriving there from the Azores, Canary, Cape Verde and Madeira Islands were badly decayed and wormy. It was recorded as a pest in Spain in 1842, in Algeria in 1858, in Italy in 1863, in Sicily in 1878, and in Tunis in 1885. In 1889 it was causing damage in South Africa. It became established in Western Australia in 1897, and in the eastern part of Australia in 1898. In 1899 it was detected in Tasmania; in 1900 it was found in orchards near Paris, France, and during 1901 it was reported from New Zealand and Brazil. Compere, in 1904, found the pest in Egypt and in Asiatic Turkey at Beirut, Jappa and Jerusalem. Argentina was reported infested in 1905. During 1916 the orange, tangerine, peach, pear, and apple crop of the Patras consular district of Greece was badly damaged. Between 1909 and 1914 it was found in the eastern and western portions of Africa. It was first found in the Hawaiian Island at Honolulu in 1910 and within two years had spread to every important island of this group. The Bermuda Islands have been infested since 1865. Reports that the Mediterranean fruit fly is established in the West Indies are unwarranted from our present information.

KNOWN INSTANCES OF ARTIFICIAL DISSEMINATION

The fruit fly was established in many of the countries listed above at the time entomologists made their first surveys, hence the dates of the first report of the insect from certain of the countries, as for instance, Spain, Italy and western Africa, do not necessarily establish a truthful chronology of spread. In fact, the west African coast region is considered the original home of the pest although it was among the last places to be found infested. To men in an uninfested country like the United States, the known instances of spread and establishment are serviceable in pointing out the avenues of spread that must be particularly guarded against.

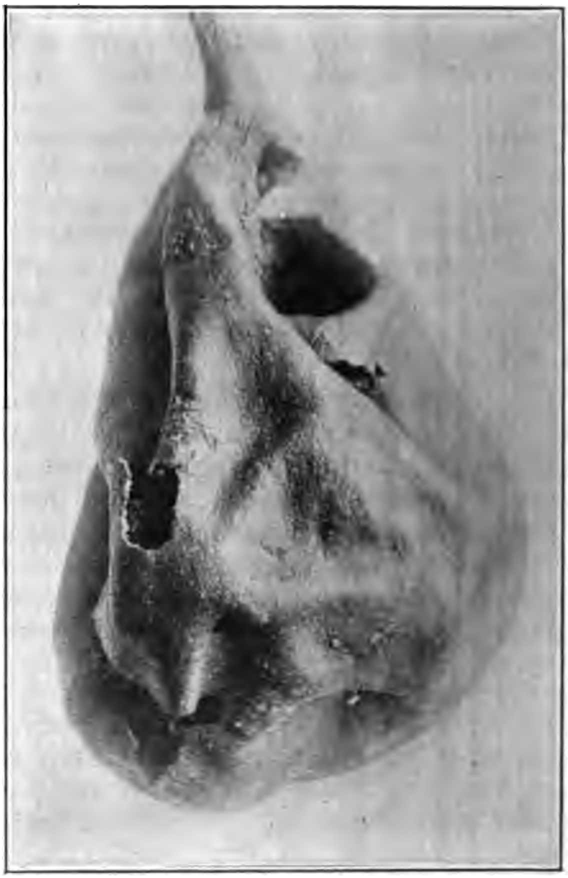

Fig. 4.—Bartlett pear, the interior of which has been entirely consumed by the larvae of the Mediterranean fruit fly. (From U. S. Dept. of Agriculture.)

The spread of the fruit fly to the eastern and western portions of Australia and to Brazil is the direct result of the development of rapid ocean transportation and cold storage which made possible the development of an export trade in citrus fruits from the infested Mediterranean region to these countries, although Brazil may have become infested via South Africa. The establishment in Hawaii at Honolulu was a sequence to the establishment in eastern Australia and was made possible by vessels plying between Australian and American and Canadian ports. It is reported that Bermuda became infested in 1865 when a vessel, bound for New York from the Mediterranean region, was blown out of its course and forced to unload its cargo containing infested fruits at St. George.

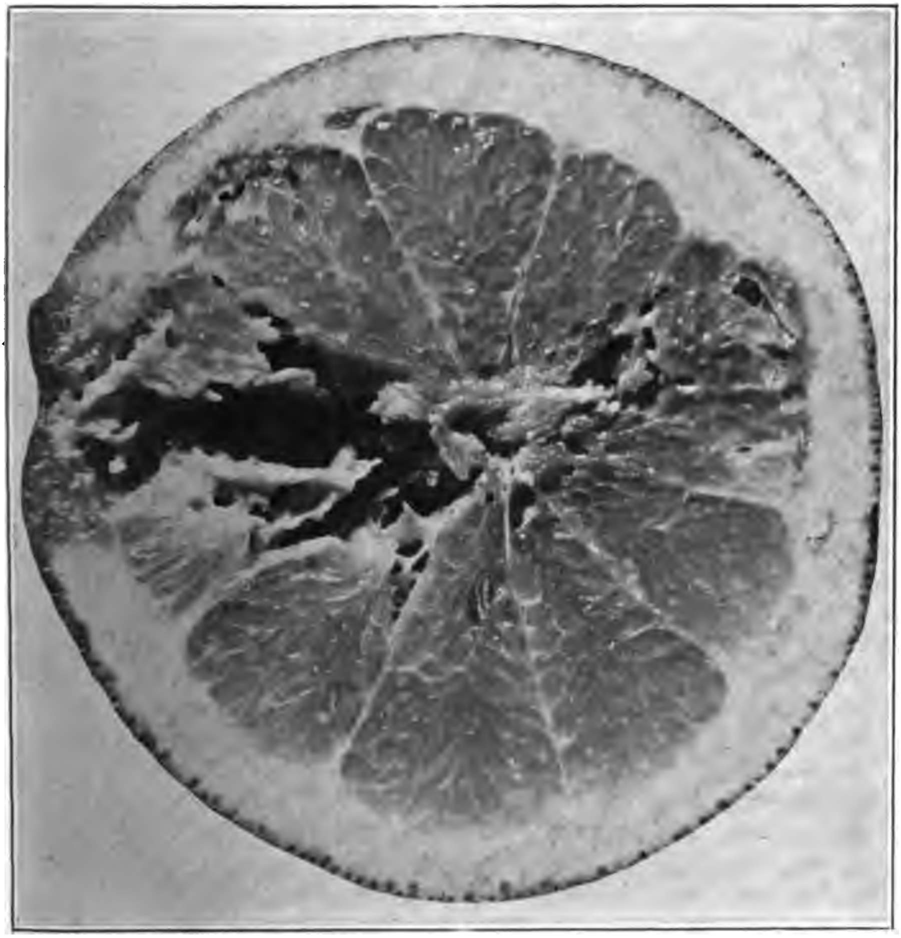

Fig. 5.—Grapefruit, showing destructive work of Mediterranean fruit fly larvae in the pulp. (From U. S. Dept. of Agriculture.)

A fruit fly pupa was discovered in New Zealand in soil about the roots of a plant imported from Australia, and in Tasmania infested fruits from Sydney are frequently condemned. In 1909, a case of peaches infested with living larvae arrived at Auckland, New Zealand, after a four-week voyage in cold storage from Cape Colony. At San Francisco, inspectors of the Federal Horticultural Board and of the California State Commission of Horticulture are almost monthly intercepting infested fruits in the ships' stores and even in the baggage and pockets of tourists returning from Honolulu. At Washington, the Federal Horticultural Board has found a living pupa of the papaya fruit fly *(T. curvicauda)* in an express package from Mexico and living specimens of the olive fruit fly *(D. oleae)* in a package of olive seed sent by mail from South Africa and destined for California where the olive fly does not occur. It is stated that many fruit fly larvae are found in London each year in oranges from Spain, imported for the manufacture of marmalade.

These are but a few of the definite instances of spread known to have occurred, yet they indicate that it is not idle to state that the Mediterranean fruit fly is nearer making a conquest of the best citrus regions of the world today than it has ever been before.

OBSTACLES IN WAY OF ESTABLISHMENT IN AMERICA

On the West

Until 1897, the Pacific Coast of North America was in no danger of becoming infested from the West by the Mediterranean fruit fly, since at that time only the countries and islands bordering on the Mediterranean Sea, Africa in general (in all probability) and the Bermudas were infested. Hence ships engaged in trade upon the Pacific and touching at North American ports plied between ports not only themselves free from infestation, but also very remote from infested countries. With the spread of the pest to Australia, from the Mediterranean countries, in 1897-8, the situation at once was changed, for direct sailings between Sydney and San Francisco and Vancouver brought the pest within striking distance of California. The "commercial jump" of the fruit fly from Australia to Hawaii, about 1910, brought the danger of establishment two weeks nearer to California ports. With the fruits of the Hawaiian Islands now thoroughly infested (except pineapples and commercial shipments of bananas), the great development in the tourist travel between the Islands and the mainland, the lowering of the sailing time between Honolulu and Hilo and San Francisco to 4½-7 days, and with the making of San Pedro a port of call for ships from Hawaii during a portion of the year, the opportunities for establishment in California have been greatly increased during the past five years. Only the untiring efforts of the quarantine officials of the Pacific Coast ports, working in cooperation with the Federal Horticultural Board, and assisted by unfavorable climatic and host conditions surrounding the docks at San Francisco, can keep the pest from gaining a foot hold on the Pacific Slope. Those who doubt this

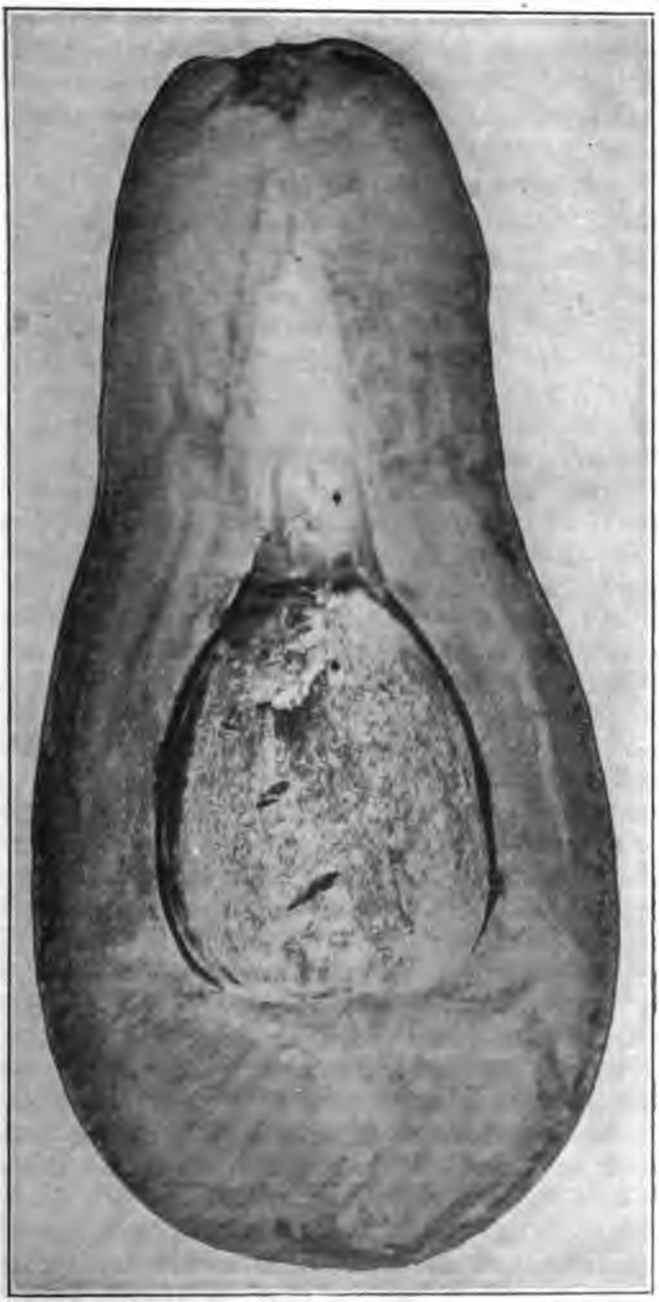

Fig. 6.—Cross section of avocado showing injury to pulp at both stem and blossom ends by Mediterranean fruit fly larvae. (From U. S. Dept. of Agriculture.)

statement should become familiar with the fruit fly situation in Hawaii and read the monthly reports of the Quarantine Division of the California State Commission of Horticulture and of the Federal Horticultural Board. The Mediterranean fruit fly is knocking at the gates of California almost monthly.

On the East

Three important factors have worked to prevent establishment along the eastern seaboard of the United States. They are checks developing out of trade and climatic conditions and the host relationships of the fruit fly. The infestation of Bermuda is the result of an unforeseen disaster at sea, as already mentioned, which put the fly ashore in a favorable climate.

Trade Conditions. Aside from lemons and grapes, the infested regions about the Mediterranean Sea export practically no fresh fruit to America. Comparatively small quantities of non-citrus fruits, except figs and grapes, are grown and those that escape attack find a ready market in Europe. Such small shipments of fresh figs, prickly pears, etc., shipped to the United States during short seasons are absorbed by the Latin colonies of larger northern cities, especially New York. Even during the past winter, when the northern European markets were largely closed to Spanish oranges because of the war, these fruits could not be profitably placed upon the New York market in competition with the Florida and California crop. In fact, the citrus crop of these two states has indirectly been for years one of the greatest trade barriers to the establishment of the fruit fly on American soil, for they have usurped the orange market, thus making shipments of Mediterranean fruits to America, outside of New York, generally unprofitable.

The nearness of Bermuda to Charleston and our southeastern coast is not the menace that it would be if its trade were not carried on with new York and England. Fresh native grown fruits in Bermuda are a rarity. The bulk of her fresh fruits are American grown and imported from New York. Fresh Bermuda vegetables shipped to the United States can only be exported profitably during the winter months and before our own southern grown truck crops can be placed on the market in competition. Furthermore, the Bermuda crops exported (potatoes, onions, and foliage crops) are not attacked by the fruit fly, and all are consumed in New York.

Host Relationships. The host relationships of the fruit fly have played their part in serving as barriers to establishment in

America. The list of fruits and vegetations subject to attack has been shown to be large, yet the number of cultivated edible fruits infested and grown in quantities sufficiently large in the Mediterranean regions to reach beyond local markets, is very small, and as far as American territory, outside of New York, is concerned, is limited to Malaga grapes and lemons. None of the host fruits are so rare as to warrant their being carried across the ocean as curiosities by tourists as is true of many fruits grown in the Pacific regions. Fortunately, Malaga grapes and lemons have been found to be as free from danger as carriers of the pest as any ordinary articles entering into transatlantic trade. This conclusion is the result of studies made by Prof. H. J. Quayle in the citrus orchards and in the curing and packing houses of Italy, Sicily, and Spain, and by agents of the Bureau of Entomology in Hawaii, supplemented by a painstaking examination by the writer of many consignments of fresh lemons arriving at the port of New York during Nov.-Dec. 1913. During the past harvesting season for Malaga grapes in Spain, the writer was authorized by the Federal Bureau to make observations in the principal Spanish grape growing regions, but found no infestations although the markets of Cadiz, Seville, Granada, Valencia, Alicante, Barcelona, Madrid, and Zaragoza were examined. Exception must be made of one instance in which a single berry out of 1,000 decaying berries in the market of Cadiz was found to contain a larva. This single infestation appeared to be of a secondary nature. Had grapes and lemons, in commercial shipments, been generally infested, larvae would have been found years ago in imported fruits. For those wishing detailed results of experimental work bearing upon the infestation of citrus fruits, there has been accumulated by the Bureau of Entomology much information that can be had on application.

Climatic checks. Adverse climatic conditions have played an important part in preventing establishment. Experiments conducted by the Bureau of Entomology in Hawaii, and observations made by the writer in Spain, indicate that the Mediterranean fruit fly will not be a pest, except possibly in late peaches, when the monthly mean temperatures fall to or slightly below 50° F. for three consecutive months during the year. In the Hawaiian Islands where climatic conditions are nearly ideal for fruit fly increase, development progresses most rapidly after the daily means reach about 78-79° F. and is about doubled when these fall to 68° F. No development occurs after the temperature falls below 50° F. and complete mortality follows if the fly is subjected to this temperature sufficiently long. An exposure of 2 to 3 weeks to 32° F. will kill all stages of the fruit fly. It is, therefore, evident that any fruit flies arriving in the northern markets would be speedily killed during the winter months or be forced to die within warehouses and stores. Even should importations of fruit yield flies during the summer months when the temperatures are not fatal, death would follow under city conditions, such as those of New York, for the adult flies cannot live more than 3 to 4 days without food, and, unaided, do not fly any distance from the point of emergence.

GREATEST DANGER FROM WEST INDIES

While there are weaknesses in the argument concerning the natural barriers to the infestation of the eastern seaboard by the Mediterranean fruit fly, it contains enough of truth to strengthen the belief of the writer that Florida's chief source of danger from infestation today lies in the direction of the West Indies. At present, the islands of the Caribbean Sea are not known to be infested by the Mediterranean fruit fly. With the opening of the Panama Canal, cargoes have been and will be shipped from Honolulu to the East, and from Australia. Spanish boats have been plying between Spain and West Indian and Mexican ports, and even Galveston and New Orleans. The fruit fly is well established in Brazil, and is said to be in Argentina. There is danger that coast-wise trading vessels will spread the infestation northward if they have not already done so. The development of trade between North and South America will increase the opportunities for spread. Mr. C. L. Marlatt, Chairman of the Federal Horticultural Board, has already planned an investigation of the sources of danger in the West Indian region that immediately concerns Florida and the Gulf States.

THE MEDITERRANEAN FRUIT FLY CAN THRIVE IN FLORIDA

After nearly four years' experience with the fruit fly in various climates of the Hawaiian Islands, and after personally investigating fruit fly conditions in Bermuda and Spain, the writer does not hesitate to say that the Mediterranean fruit fly is capable of becoming a most serious pest in any part of Florida so far as the climate is concerned.

In Table I are given the monthly mean temperatures, accompanied in most instances by the means of the maxima and

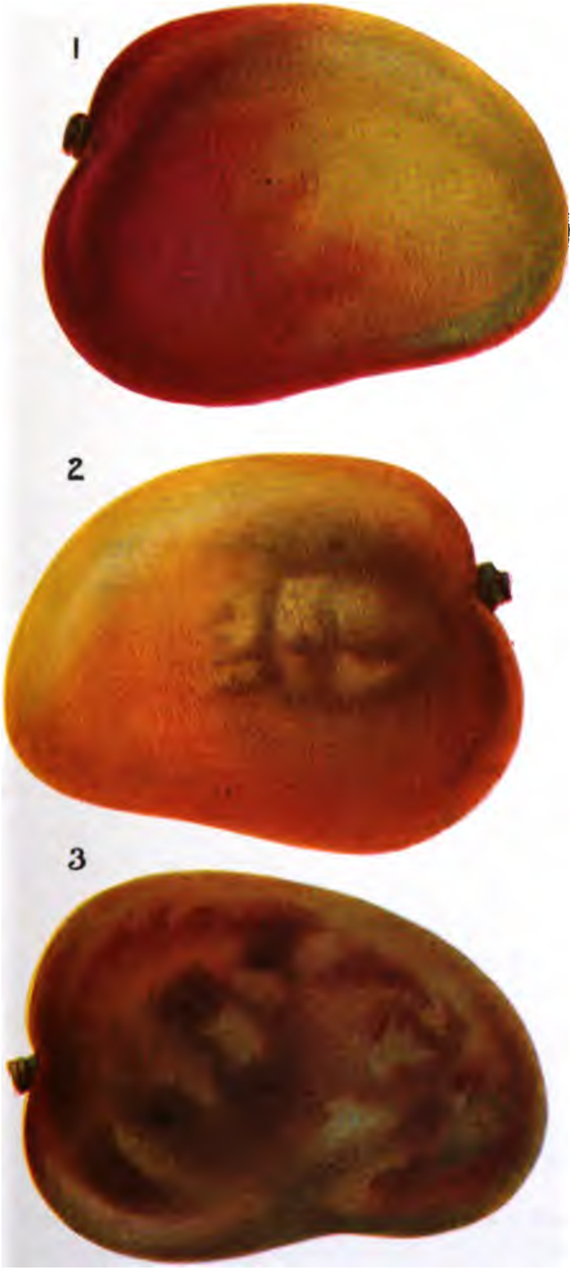

Plate XXV.—Mangoes and the Mediterranean Fruit Fly. Mangoes, particularly the seedling sweet mangoes, are favorite hosts of the Mediterranean fruit fly. Above are shown three fruits in various stages of infestation. 1, A ripe fruit containing eggs of the fruit fly. The breaks in the skin through which the eggs have been laid are so small that they are not to be seen except by the trained eye, hence the fruit appears uninfested. After the larvae hatch and begin to burrow about in the pulp beneath the skin, they cause decay to set in and these decayed spots, showing dark colored through the skin, give evidence of the destruction caused by the larvae. 2. A fruit in which the larvae are still young. 3, A fruit in which the larvae are well grown and have caused much damage.

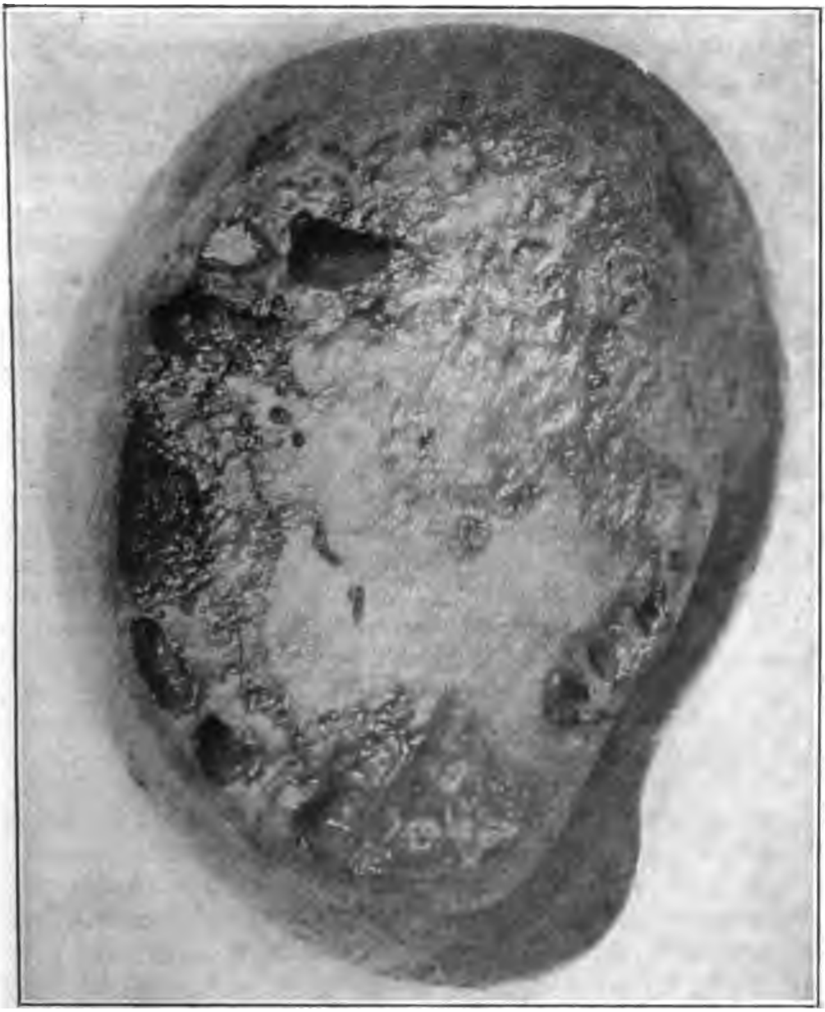

Fig. 7.—Mango, cut open to reveal cavities made in the pulp by larvae of the Mediterranean fruit fly. In upper left-hand side can be seen a cavity containing the whitish eggs deposited by the adult female. (From U. S. Dept. of Agriculture.)

minima temperatures, for Barcelona, Valencia, Zaragoza, and Cordoba, Spain, of Key West, Miami, Ft. Myers, Bartow, Eustis and Tallahassee, Florida, and of Bermuda.

At Barcelona during the last October the writer found practically all the late peaches on the market infested, and the Japanese persimmons, apples and very many of the earlier ripening oranges upon the trees, both within the city limits and in the neighboring farming districts, quite generally attacked. At Valencia, Japanese persimmons, quinces, and a few apples were infested while practically all of the earlier ripening and highly colored oranges bore fruit fly punctures. However the bulk of the citrus crop about Valencia which had not then (November) turned a deep color, was free from attack. At Zaragoza, only late peaches were found infested; excellent apples and quinces, said to have been grown just outside of the city, were free from infestations or deformities resulting from fruit fly attack. Quinces grown in the region of Cordoba were badly infested—not a single uninfested fruit was found—and practically all the apples from near this place, in the markets of Cadiz during late November, showed evidence of attack, though comparatively few contained larvae.

It has already been stated that the fruit fly develops most rapidly after the daily means rise to 78°-79° F. In Honolulu, when the temperature is about 79° F., the immature stages may be completed in as few as 13, or as many as 33 days, according to the individual and its host, although the largest number become adult in from 18 to 20 days. The developmental period for the immature stages is about doubled when the monthly mean drops to 68° F., while practically no development occurs at 50° F. and no development below this point. Yet, the fruit fly can withstand lower temperatures for varying lengths of time. Thus, 62 of 248 larvae lived through an exposure of 21°-28° F. for 5 days, or a period fatal to most of Florida's crops. An exposure to an even temperature of 32° F. for 4 days had little effect upon larvae infesting apples. Development proceeds, though slowly, at temperatures between 52°-58° F. In Hawaii, in fruit-growing districts where the winter monthly means drop to about 68° F., the fruit fly is a serious pest. Additional data may be had upon the effect of low temperatures upon the fruit fly on application to the Bureau of Entomology. Bearing in mind the statements regarding infestation, given above, a comparison of the temperature means, in Table I, of the Spanish and Florida districts, leaves no doubt that the fruit fly will maintain itself easily under Florida climatic conditions.

CONCLUSION

While conditions in the past have not favored the establishment of the Mediterranean fruit fly in California and the Gulf Coast States, the opportunities for spread to these states have been greatly increased during the past few years. With the spread of the pest to the Hawaiian Islands in 1910, infested

fruits have been intercepted and condemned at the port of San Francisco on an average of about once a month.

Florida's greatest danger of infestation appears to lie in the direction of the West Indies, since with the opening of the Panama Canal and the development of trade between North and South America, this is the region through which pass vessels from Hawaii, Australia, Brazil, Argentina, and the Mediterranean countries—countries all now infested. There is every reason to believe that the Mediterranean fruit fly will become a serious and ever present pest if once established in Florida. While climatic conditions are favorable to its increase, the dearth of native or wild host fruits will make possible a successful, though very troublesome, campaign for its subjugation.

TABLE I.—Containing the monthly mean temperatures, with the mean of maxima and minima temperatures, of points in Spain, Florida and Bermuda infested by the Mediterranean fruit fly.*

Locality	Mean of	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Barcelona	maxima	55	57	60	64	70	79	81	84	78	75	64	59
	minima	40	39	42	46	53	60	64	67	61	56	48	44
Valencia	maxima	51	55	58	59	65	70	73	77	73	65	58	53
	minima	45	50	52	56	62	66	69	74	62	63	55	50
	monthly	50	52	55	59	64	70	76	77	72	65	57	51
Zaragoza	maxima	46	58	63	69	72	76	82	84	81	69	56	51
	minima	30	41	43	47	52	55	60	61	56	50	39	37
	monthly	38	49	53	58	62	66	71	73	69	59	47	44
Cordoba	maxima	54	60	65	71	77	83	93	96	92	76	62	56
	minima	36	43	45	50	54	57	65	66	64	55	46	44
	monthly	45	51	55	61	65	70	79	81	78	65	54	50
Key West	maxima	74	76	77	80	84	87	89	89	87	83	78	74
	minima	65	67	68	71	75	78	79	79	78	75	71	66
	monthly	70	71	73	76	79	82	84	84	85	79	74	70
Miami	maxima	74	76	80	82	86	89	89	90	88	84	80	76
	minima	57	59	64	64	69	74	76	75	74	71	67	61
	monthly	65	67	71	74	76	81	82	82	81	78	74	69
Ft. Myers	maxima	72	74	79	82	86	88	88	88	86	82	77	72
	minima	52	54	58	61	66	71	73	74	73	68	61	55
	monthly	62	65	68	72	77	80	81	81	80	75	70	64
Eustis	maxima	69	71	77	82	89	91	92	92	89	83	76	70
	minima	48	50	54	59	56	71	74	73	72	64	56	50
	monthly	58	61	67	70	77	81	83	83	80	73	66	60
Tallahassee	maxima	60	63	71	77	85	88	88	87	85	76	68	62
	minima	42	44	51	56	64	70	72	72	69	60	50	44
	monthly	52	55	60	67	75	79	80	80	77	68	59	53
Bermuda	monthly	62	62	64	66	71	78	80	81	78	74	69	65

***Temperatures are for following periods: Barcelona, 10 years; Valencia, monthly means, 30 years; Zaragoza and Cordoba, for 1914; Bermuda, 4 years; Florida points, 10 to 30 years.**

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING JUNE 30, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending June 30th, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING JUNE 30, 1917

Citrus grove trees inspected	4,476,804
Citrus nursery trees inspected	18,557,736
Inspectors employed	363
New properties showing infection	12
Total properties showing active infection	33
Grove trees found infected	266
Nursery trees found infected	26
Counties in which active infections were found	7

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,629
Nursery trees found infected since May, 1914	342,254
Number properties infected to June 30, 1917	454
Properties declared no longer "danger centers"	338
Properties still classed as "infected" June 30, 1917	116

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1917:

1914		1915		1916		1917	
		Jan.	306	Jan.	86	Jan.	14
		Feb.	165	Feb.	21	Feb.	4
		Mar.	444	Mar.	49	Mar.	9
		Arpil	408	April	49	April	169
May	108	May	1042	May	338	May	52
June	160	June	772	June	450	June	45
July	275	July	651	July	349		
Aug.	1313	Aug.	1345	Aug.	219		
Sept.	767	Sept.	618	Sept.	124		
Oct.	565	Oct.	214	Oct.	451		
Nov.	773	Nov.	494	Nov.	131		
Dec.	366	Dec.	256	Dec.	27		

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING JUNE 30, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

Ships and Vessels Inspected:

From foreign ports	428	
From U. S. ports other than Florida	252	
From Florida ports	427	
Total		1107

Shipments Inspected:

Arriving by water:		
Passed	28	
Treated and passed	4	
Returned to shipper	52	
Detained, subject to return	0	
Contraband destroyed	266	
		350
Arriving by express, freight, etc.:		
Passed	275	
Treated and passed	16	
Returned to shipper	7	
Detained, subject to return	25	
Contraband destroyed	21	
		344
Total shipments inspected		694

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or disease	Occurring on	From	Number of shipments infested
Aspidiotus hederae	Chinaberry	Florida	1
Aspidiotus lataniae	Chinaberry	Florida	1
Bephrata cubensis	Soursop	Cuba	1
Crown gall	Currant	New Jersey	1
Crown gall	Rose	Florida	1
Crown gall	Rose	Pennsylvania	1
Crown gall	Rose	New York	2
Dictyospermum scale	Citrus	Spain	1
Florida red scale	Herbaceous plants	Florida	1
Florida red scale	Palms	Cuba	1
Florida red scale	Palms	Florida	1
Long scale	Citrus	Cuba	1
Mealy-bug	Palm	Florida	1
Melanose	Citrus	Florida	1
Purple scale	Citrus	Cuba	1
Purple scale	Citrus	Florida	1
Nematode root-knot	Chinese medicine plant	Florida	1
Nematode root-knot	Fig	North Carolina	1
Nematode root-knot	Fig	Florida	3
Nematode root-knot	Hibiscus	Alabama	1
Nematode root-knot	Japonica	Georgia	1
Nematode root-knot	Plumbago	Florida	1
Nematode root-knot	Rose	Florida	1
Rufous scale	Croton	Cuba	1
Rufous scale	Pandanus	Cuba	1
San Jose scale	Peach	Georgia	1
San Jose scale	Plum	Illinois	1
San Jose scale	Prune	Illinois	1
Soft brown scale	Jasmine	Florida	1
Soft brown scale	Lily	Florida	1
Soft brown scale	Maguey	Florida	1
Sweet potato root weevil	Sweet potato	Cuba	3
Whitefly	Chinaberry	Florida	1
Whitefly	Jasmine	Florida	2

PARCEL POST PLANT INSPECTION

QUARTER ENDING JUNE 30, 1917

Parcels Inspected:	
Passed	1796
Treated and passed	76
Returned to sender	1
Detained, subject to return	7
Infested or infected parcels destroyed	16
Total Parcels Inspected	1896

PESTS INTERCEPTED

Name	Found on	From	No. of Shipments
Citrus mealy bug	Coleus	Ohio	4
Crown gall	Apple	Nebraska	1
San Jose scale	Chinaberry	Florida	1
San Jose scale	Peach	Illinois	1
San Jose scale	Peach	Kentucky	1
Nematode root-knot	Canna	New York	1
Nematode root-knot	Chrysanthemum	Ohio	7
Nematode root-knot	Chrysanthemum	Florida	1
Nematode root-knot	*Dioscorea*	Illinois	1
Nematode root-knot	Fig	Florida	1
Nematode root-knot	Geranium	Ohio	1
Nematode root-knot	Geranium	Florida	1
Nematode root-knot	Grape	Pennsylvania	1
Nematode root-knot	Grape	Tennessee	1
Nematode root-knot	Hibiscus	Ohio	2
Nematode root-knot	Lemon verbena	Ohio	1
Nematode root-knot	Lilac	Ohio	1
Nematode root-knot	Rose	New York	1
Nematode root-knot	Rose	Ohio	71
Nematode root-knot	Rose	Indiana	1
Nematode root-knot	Rose	Illinois	1
Nematode root-knot	Rose	Louisiana	1
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Snowball	Ohio	1
Nematode root-knot	Tomato	Florida	2
Nematode root-knot	Tomato	Georgia	1

THE GROWER'S NEED OF A HAND LENS

F. M. O'BYRNE

The grower should familiarize himself with the various insect pests which he finds on his crops so that he will know what to expect when an insect is appearing in considerable numbers. Some insects make their presence known so suddenly that by the time specimens can be sent to an authority for identification and an answer received, the damage accomplished may be considerable, and control measures rendered worthless because of lost time.

A magnifying glass or hand lens enables the grower to secure much useful information by direct observation.*

Recently the writer was talking to a successful orange grower and was surprised to learn that this grower had no magnifying glass. Upon being asked how he was able to control scale in his grove, the grower replied that he was a practical man and followed practical methods; that when the scale in his grove got bad he sprayed, that he repeated this spraying three weeks afterwards, and if the infestation was severe he gave a third spraying. Each spraying cost him fifty dollars. Had this grower possessed a hand lens and with it observed the development of the young scale-insects, he could have made one spraying, or at least two, accomplish the work of his three rule-of-thumb sprayings.

Scale-insects frequently make their appearance in broods. Certain conditions, such as drouths or spraying with fungicides like Bordeaux mixture, usually result in a rapid increase of scale-insects provided the grove is at all infested. By the use of a hand lens from time to time, the grower is able to tell when a new brood is coming on by observing the tiny insects or crawlers upon the tree. If he sprays when the oldest of the young insects are about three or four weeks old, the one spraying is likely to accomplish as much as the three sprayings given by our friend mentioned above.

On the other hand, if the grower waits until his trees show heavy infestation of adult scales before spraying, it is impossible for one spraying to bring them under control, and a fractional spraying, involving at least three separate applications is necessary.

All spraying work should be intelligently planned and executed. The grower should know when to spray and why, and the intelligent use of a magnifying glass will go far towards giving him this much needed information.

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*The more common insects can be identified by the grower himself if he is supplied with a good text book on entomology written in language he can readily understand. "Injurious Insects; How to Recognize and Control Them," by O'Kane (MacMillan, New York, 1914) or "Insect Pests of Farm, Garden and Orchard," by Sanderson (John Wiley and Sons, New York, incorporated, 1915), are both good.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner* .... *Editor*

ASSOCIATE EDITORS.

E. W. BERGER .... *Entomologist*
F. M. O'BYRNE .... *Nursery Inspector*
R. A. JEHLE .... *Asst. Plant Pathologist*
FRANK STIRLING .... *General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

NURSERY STOCK AND SCALE INSECTS. If buying a cow—which would you buy; one raised free from ticks from the start or one which had been neglected and had been tick-infested all its life, but which was dipped and cleaned up at the last moment? You would buy the one which had been tick-free all its life of course, and the man who raised cattle thus carefully would make more money out of his cattle than the other. His cattle would be worth more to all. Would not the same reasoning apply to the growing and selection of nursery stock?

Too many nurserymen and grove-owners who grow their own stock, consider it good business practice to allow it to grow up in any sort of condition, cleaning it up at the last minute before selling or using the trees. This is undoubtedly poor business practice from an economic point of view. A scale-infested nursery is a constant source of trouble and expense, and adequate spraying in a nursery is difficult and expensive. It is not such a difficult matter to grow stock scale free from the start. Seed beds should be located as far as possible from scale-infested stock. When seedlings are "lined out" in rows all those infested should be discarded or thoroughly scrubbed, and they should be *absolutely free* from scale before planting.

Some will say this is useless, as the top will be cut off and removed as soon as the buds are large enough. But while the young bud is putting out from an infested seedling, young scale insects are hatching and crawling onto it. Some scales are left below the union, and their young crawl onto the young bud. As a result of such practice the young tree is scale-infested from the very start. If the stock is free from scale, so will the budded stock be free nine hundred and ninety-nine times in a thousand.

In the spring of 1916 a nursery of 3,600 citrus seedlings was planted by the Nursery Inspection Department of the State Plant Board. Beginning July 1st, 1916, this nursery was sprayed periodically with a fungicide. A number of blocks have been sprayed weekly with Bordeaux mixture since that date, and have not been treated even once with an insecticide. Every grower knows in what a severely infested condition this stock would have been had it had even the slightest scale infestation when planted. They were scrubbed free from scale before they were planted, however, and, as a result, they are still free from scale, although standing within fifty paces of infested trees. This is but one of many instances which could be cited, all of which demonstrate conclusively that it pays the producer to *grow* his stock clean from the start, and thus secure far stronger, better trees. They are the kind of trees you would want to get if you were buying.—F. M. O'B.

RED ASCHERSONIA. This fungus, commonly called the Red Whitefly Fungus, was first discovered in Florida in 1893, by Dr. H. J. Webber of the U. S. Dept. Agr., in the citrus grove of Mr. J. H. Harp at Crescent City. Dr. Webber not only discovered its usefulness as a whitefly destroyer, but described and gave it its scientific name. Dr. Webber also found that he could introduce this fungus into other whitefly-infested trees and groves by pinning fungus-bearing leaves beneath leaves infested with whitefly and by planting small trees with fungus so that their leaves would touch the other leaves.

When the writer came to the State in 1906, as Entomologist of the Florida Experiment Station, Professor P. H. Rolfs, Director, showed him a whitefly-infested tree and advised that the control of this pest would be his immediate and principal problem. The fungus problem, of course, went with the larger problem. It was the writer's good fortune to be able to show, after a few months' experimenting, that the Red Aschersonia could be readily started on the whitefly by simply spraying with a mixture of the fungus spores and water.

Following the good results with the spraying plan of introducing fungus, this method soon became popular and hundreds of thousands, if not millions, of trees were sprayed by grove owners, and by others who engaged in commercial spraying of the fungus.

While this was in progress, Prof. H. S. Fawcett, Plant Pathologist of the Florida Experiment Station, was conducting his scientific studies of the fungi parasitic on the whitefly, and developed his method of growing pure cultures of the Red Aschersonia on sterilized sweet potato. The writer soon undertook the growing of similar cultures; at one time producing as many as 50 pint-bottle cultures. This was in 1909 or 1910, but as there was no apparent need of an artificial supply of fungus at that time the production of pure cultures was discontinued.

Following the advent of citrus canker the possible danger of spreading canker by collecting fungus directly from trees became evident. The Plant Board then instructed its Department of Entomology to grow the Red Aschersonia in pure cultures in large quantities. Last year (1916) 358 salable cultures were produced and 328 sold to growers while this year between 1,500 and 1,800 salable cultures have been made ready.

Nearly all the work of producing this year's cultures has been done by Mr. C. E. Wilson, Assistant Entomologist. These cultures are now for sale at 50c each, the purchaser paying transportation charges. A culture is sufficient for an acre of grove, and when packed for shipment, weighs about 1 pound. Directions for using the cultures are sent with each order. The period of summer rains, now on, is the time to introduce the fungus. Growers having whitefly in their citrus groves are urged to use the fungus at once even if the whitefly is not abundant, in order to get it established before the late summer brood of flies emerges.

All orders should be sent to the Department of Entomology, State Plant Board, Gainesville, Fla. Checks and money orders should be made payable to the State Plant Board.—E. W. B.

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THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II OCTOBER, 1917 No. 1

THE ROLL OF HONOR

The following employes of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
Barcus, Geo. D.	Aviation Section
Bradford, Horace	Federalized National Guard
Branam, Jas. R.	Navy
Butts, J. L.	Ambulance Corps
Calcote, W. H.	Officers Reserve Corps
Cary, Chas. L.	National Army
Chandler, L. L.	Navy
Dickey, Edward K.	Officers Reserve Corps
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	National Army
Goldsby, Jack	Ambulance Corps
Green, Guilford	1st Lieut., Federalized Nat'l Guard
Grimes, D. W.	Aviation Section
Harrison, C. J.	Aviation Section
Hood, Richard Van	Lieut., Marine Corps
Howell, John F.	Officers Reserve Corps
Lovett, J. C.	Ambulance Corps
Little, Floyd L.	Aviation Section
Maloney, Clarence B.	"Somewhere in Europe"
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Navy
Smith, J. G.	National Army
Stephens, Chas. M.	National Army
Swann, Porter R.	Sergt., Cavalry
Walker, Geo. S.	Aviation Section
Whittington, C. E.	Officers Reserve Corps
Wilson, Guy H.	2nd Lieut., Field Artillery

SOME FLORIDA SCALE-INSECTS

C. E. Wilson

In May of 1916 the author became an inspector of the State Plant Board of Florida and, failing to find any literature on Florida scale-insects other than scattered papers, the need of such a publication was, time after time, forcibly brought to his attention. The opportunity for bringing together this literature was, however, not presented until February of 1917, when he was transferred from field inspection work to the Entomological Department of the State Plant Board at Gainesville.

Noting the number and species of the scales daily sent to the Entomological Department for identification by inspectors in the field it was decided, after a brief conference with Mr. Wilmon Newell, Plant Commissioner, and Dr. E. W. Berger, Entomologist, to undertake the work of listing, illustrating and briefly describing the Florida species.

The original intention of the author was to make this a technical report, but on the advice of the Plant Commissioner and Entomologist, it was decided to prepare, as nearly as possible, a practical bulletin for the use of the field inspectors and grove owners.

In arrangement of species it was decided to use the common name instead of generic name, as it would probably prove more convenient for practical usage.

The amount of time given to the preparation of this report has not permitted the listing or collecting of all the Florida species, but it is hoped that this paper will prove to be an introduction for the continuation of the work on Florida scales.

The food plants herein listed are divided into two groups, namely: those found to be infested in Florida, and those which are known to be infested, but so far not taken in Florida.

The distribution as given for Florida includes only the localities from which specimens have been received or taken by the author.

Methods of control for scale-insects are treated of by Dr. Berger in a separate article in this issue.

I desire to make acknowledgment to Messrs. Wilmon Newell and Dr. E. W. Berger for various criticisms and suggestions.

To the assistant nursery inspectors, and more especially to Messrs. F. F. Bibby, F. W. Poos, Jr., and U. C. Zeluff, am I indebted for the zeal and enthusiasm with which they collected material for identification. To Professor J. R. Watson, Entomologist of the Florida Agricultural Experiment Station, I am indebted for specimens, literature and the distribution of several of the species herein listed and to Mr. Julius Matz, of the Florida Experiment Station, for assistance in photographing specimens. To Mr. E. R. Sasscer of the Federal Horticultural Board, I am indebted for his courtesy in determining and verifying a number of species of which I was in doubt, and to Dr. L. O. Howard, Chief of the Bureau of Entomology, and Mr. A. A. Girault for determination of several parasites. Miss Ella M. Evans, stenographer in the Entomological Department, has faithfully assisted the author in preparation of the manuscript.

GROUPING AND CHARACTERS OF FLORIDA SCALES

Scale-insects may be conveniently divided into two groups, the "armored" scales and the "unarmored" or soft scales. The armored scales are those forming a protective covering over the body. This covering is caused partly by excretion from the insect, and partly by the molted or cast skins. This group of scale-insects soon settle down to feed, after being hatched, and losing their legs also lose the power of locomotion, so cannot change their position.

The unarmored, or soft scales, are those which secrete no protective covering, and retain their legs and power of locomotion throughout life; however, they do not move much after they have started feeding, except in the case of the cottony cushion-scale and mealy bugs. In the case of the wax scales and the Lecaniums a migration of the older scales from the leaf to the twig frequently occurs.

In both groups the males, in the early stages, are similar to the females, but later in life they pupate and finally emerge as minute, two-winged insects which resemble gnats. The winged males are short-lived individuals and their only function is the fertilization of the females. They possess no mouth parts and do not feed during their life.

The majority of our important scale-insects belong to the armored scales. The habits of the species of this group are similar. The eggs are produced in large numbers, a single female producing from 100 to 500. These are deposited under the scale covering of the mother and undergo a period of incubation before hatching. In some cases we find the young partly or fully developed within the body of the female from which they emerge as active insects. The young of all armored scales are similar, and are not distinguishable without the aid of a microscope. They are very minute yet are visible to the unaided eye and during the breeding season may, by close inspection, be found on leaves, stems or fruits. For the most part the color of the young scales is light yellow or light orange. In all cases the young of armored scales have six well developed legs, and also possess eyes and antennae. Shortly after emerging from the egg (from a few minutes to an hour or two) the young find a suitable resting place and settle down, thrusting their long thread-like beaks into the plant, and commence to grow. The first evidence of growth is the secretion of waxy filaments on the upper surface of the body. This is the beginning of the scale-covering. The waxy secretion continues during the life of the insect and the scale-covering is enlarged as the insect increases in size. The females of the armored scales undergo two molts and the cast skins form a definite part of the scale-covering. After the second molt the female soon reaches full size and, after being fertilized by the male, begins to develop her brood.

The early stages of the male correspond exactly to the early stages of the female, but on the second molt the male development diverges entirely from that of the female. The old skin is thrust out from beneath the scale-covering and does not become a part of it. In the second molt the antennae, legs and wings are partly developed. The third molt results in the final pupal stage. The fourth and last molt produces the perfect male which escapes from beneath the scale-covering and is able to fly about. The length of time for the molting varies for different species; however, the full growth is reached in from four to six weeks in summer and in winter the development is slower.

The female scale-insect never moves from her position after she thrusts her beak into the tissue of the plant and if removed by force soon dies. From the habits of the armored scales it is readily seen that the spread of the insects is limited entirely to the larval stage.

In the second group, or the unarmored scales, we find the ones that possess no waxy secretion or armor as a covering. The development for the species of the unarmored group is similar. All species retain their power of locomotion throughout life and are not marked by the retrograde development of the armored scales. In all cases they excrete honeydew in which develops a black "sooty mold" or fungus, covering the foliage of the infested plants. The life histories of the unarmored species are similar to that of the armored species.

EXPLANATION OF TERMS

The terms "scale of female" and "scale of male" are applied in this paper only to the thin covering on the dorsal surface of the body of the scale-insect. It is composed partly of an excretion from the insect and partly of molted or cast skins.

The term "ventral scale" when used applies only to the covering found between the body of the scale-insect and the bark of the plant to which it is attached.

The term "exuviae" is applied only to the molted larval skins which form a part of the scale. The position of the exuviae is indicated in each case as "central," meaning center of scale, "sub-central," meaning near the center but to one side, or between the center and the outer margin of the scale, and "marginal," meaning near the outer margin of the scale.

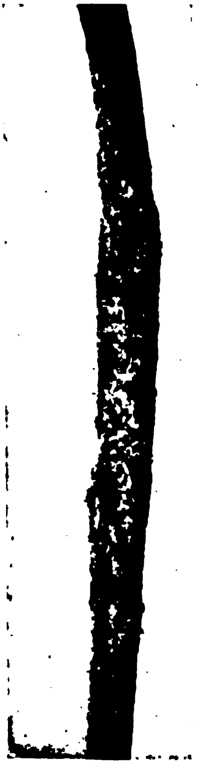

Fig. 1.—The Aspidistra Scale, *Hemichionaspis aspidistrae* (Sign.), on *Jacquemontia pentantha*. Enlarged twice. (Original.)

ASPIDISTRA SCALE

Hemichionaspis aspidistrae (Sign.)

Scale of Female.—The scale of the female is from 1.5 mm. to 2.2 mm. (1/16 to 1/11 inch) in length. It is usually broadly rounded at the posterior end. It is semitransparent, flat and of a pale brown color. The exuviae are about the same color as the scale and are rather conspicuous.

Scale of Male.—The scale of the male is elongated and slender. It is white in color, tricarinate and the exuviae are light yellow.

Plants found infested in Florida: Asparagus fern; *Aspidistra lurida; Asplenium serratum;* Boston fern; budwert fern, cocoanut palm.

Other plants liable to become infested*: *Acacia melanoxylon; Areca catechu; Cocos plumosa; Cyanotus; Davallia moorei;* fig; mango; orange; orchids; pepper tree.

Distribution in Florida: Clearwater; Ft. Myers; Little River; Oneco; Orlando; Palatka; Tampa; West Palm Beach.

---

* i. e. Other known host plants.

Aspidiotus cydoniae Comst.

Scale of Female.—The scale of the female is about 3/50 inch (1.5 mm.) in diameter. It is convex, grayish or brownish in color and somewhat transparant. The exuviae are subcentral and are dark brown or black in color.

Scale of Male. The scale of the male is similar to that of the female, but smaller.

Plants found infested in Florida: quince.

Other plants likely to become infested: cactus, fig, *Jasminum, Lantana,* orange, palms, tea-plant.

Remarks: This scale has not been received in this office up to the present time, but was described from Florida specimens by Prof. J. H. Comstock.

Aspidiotus pseudospinosus Woglum

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter and is circular or somewhat oval in shape. It is slightly convex and is usually covered by a brown fungus.

Plants found infested in Florida: *Andromeda* sp.; live oak.

Other plants liable to become infested: oaks.

Distribution in Florida: Ft. Pierce; Lake Butler; Lake City; West Palm Beach.

Remarks: The author is indebted to Prof. J. R. Watson of the Florida Experiment Station for the record of this scale, on *Andromeda* sp. This scale was originally described from specimens collected from Florida on saw palmetto by W. H. Field in 1882.

BAMBOO SCALE

Asterolecanium bambusae Bdv.

Scale of Female. The scale of the female is from 2 mm. to 2.5 mm. in length. It is oval, convex above, glassy, semitransparent and colorless or tinged with green or yellow. It is elongated and narrowed slightly behind.

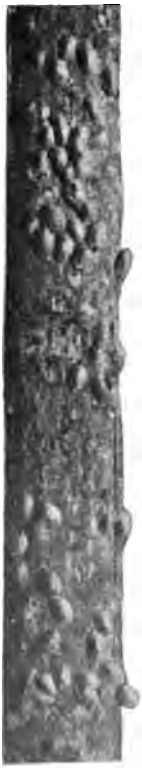

Fig. 2.—Bamboo Scale, *Asterolecanium bambusae* Bdv., on bamboo. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is not known.

Plants found infested in Florida: bamboo; *Bambusae vulgaris;* persimmon.

Distribution in Florida: Avon Park; Bradentown, Clearwater; DeLand; Ft. Myers; Gainesville; Kissimmee; Lakeland; Little River; Lutz; Miami; Orlando; Tampa; Terra Ceia; Waverly; West Palm Beach.

BARNACLE SCALE

Ceroplastes cirripediformis Comst.

Scale of Female.—The scale of the female is 4 mm. in diameter, 4 mm. high and 5 mm. long. The waxy covering is dirty white, mottled with several shades of gray or light brown plates. There is one large convex dorsal plate and six lateral ones, each with a central nucleus.

Plants found infested in Florida: citrus, guava, wild persimmon.

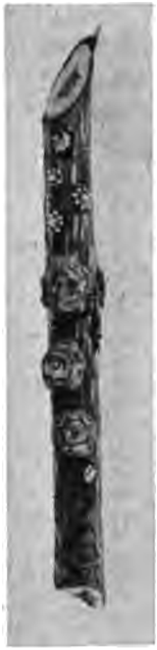

Fig. 3.—Barnacle Scale, *Ceroplastes cirripediformis* Comst., on persimmon. Slightly enlarged. (Original.)

Other plants likely to become infested: *Eupatorium, Lignum-vitae,* myrtle, quince, and *Solanum.*

Distribution: This scale is generally distributed throughout the State, but is of slight economic importance.

BLACK LECANIUM

Lecanium nigrofasciatum Pergande

(Fig. 4)

"The shape is oval, broader posteriorly, and hemispherical. The cuticle varies in color from light or dark red to black, with the median stripe lighter and with small clear areas each of which contains a very small dot. There are also a few small sets scattered on the dorsal surface. Length, 3-4 mm.; width 2.6 mm. The antenna has six segments, the third, which is the longest, having three setae. The anal plate is nine-sixteenths as broad as long with the cephalo-lateral and caudo-lateral margins sub-equal, and with the lateral extremity and apex sharp, and a faint scar close to cephalo-lateral margin near the lateral extremity. There are two subapical and three apical setae with two of the latter on the outer lateral margin and one a slight distance from the apex. There are four fringe setae in groups of two with the inner two one-half as long as the outer. The middle spiracular seta is broader at the apex than at the base and the other two are slightly tapering. The marginal setae are short, hair-like and acuminate. On the dorsum, there is an irregular row of about thirty low, conical appendages extending along the meson in front of the plates."

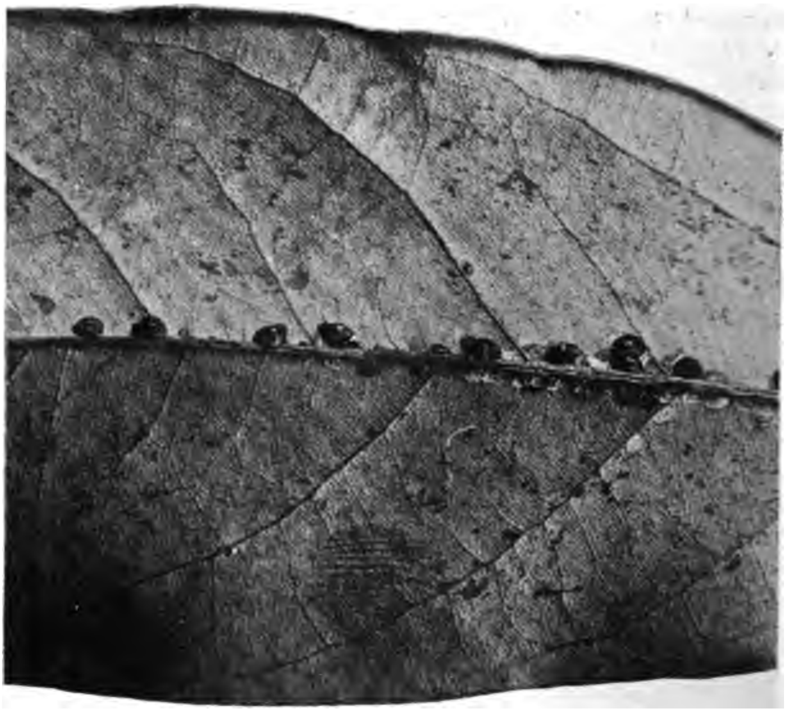

Fig. 4.—Black Lecanium, *Lecanium nigrofasciatum* Perg., on oak. Slightly enlarged. (Original.)

Plants found infested in Florida: bay; blueberry; oak.

Other plants liable to become infested: apple; birch; linden; maple; olive; peach; plum; *Vaccinium.*

Distribution in Florida: Ponce Park; Sebring.

Remarks: The above description is copied from that of Wm. C. Thro (Cornell University Experiment Station Bulletin 209, page 211, 1903).

BLACK SCALE

Saissetia oleae (Bern)

Adult Female.—The length of the adult female is from 2 mm. to 5 mm. (1/8 inch to 1/4 inch). It is black or dark brown in color, rather hard, almost hemispherical and has a distinct "H" on the dorsal surface.

Adult Male.—The adult male is light yellow in color and very minute.

Plants found infested in Florida: avocado; fern; *Ficus aurea; Ficus elastica; Ficus indica; Glycosmis pentaphylla;* guava; *Lagerstroemia;* mango; mountain ebony; pigeon pea; *Rheedia aristata; Rheedia edulis; Sapodilla;* Spanish needle; *Terminalia;* tropical almond.

Other plants liable to become infested: almond; *Antidesma;* apple; apricot; aster; *Camellia; Chrysanthemum; Eucalyptus; Ficus pandurata;* fig; grape; *Grevillia;* holly; Irish juniper; laurel; locust; magnolia; maple; mountain ash; nightshade; oleander; olive; orchids; Oregon ash; palms; pear; pepper tree; phlox; plum; pomegranate; poplar; privet; prune; rose; Sago palm; sumac; sycamore, *Vitis;* watermelon.

Distribution in Florida: Bradentown; Clearwater; Cocoa; Delray; Ft. Myers; Ft. Pierce; Miami; Oneco; Palm Beach; Redland; West Palm Beach; Winter Haven.

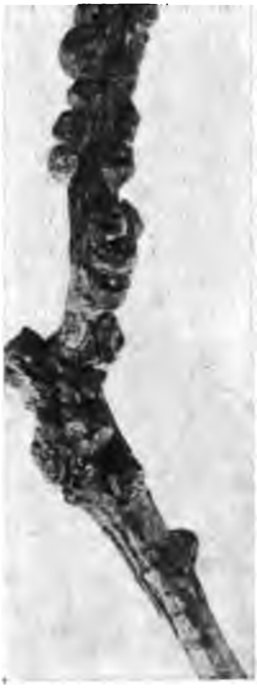

Fig. 5.—Black Scale, *Saissetia oleae* (Bern), on *Ficus aurea.* Slightly enlarged. (Original.)

Remarks: Specimens of *Saissetia oleae* collected at West Palm Beach, Florida, were infested with a scale-eating moth, *Laetilia coccidivora.*

BLACK THREAD SCALE

Ischnaspis longirostris (Sign.)

(Fig. 6)

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. (1/12 inch to 1/8 inch) in length. It is long, narrow and somewhat convex. The sides are almost parallel, the posterior margin being slightly broader. The color is shining black with slightly grayish margins.

Plants found infested in Florida: *Dictyosperma rubrum;* Gog palm; *Ixora parviflora; Lantania;* mango; Phoenix palm.

Other plants liable to become infested: *Ficus* sp., jasmine; *Magnolia grandiflora; Monstera;* palmetto; palms; *Pandanus.*

Distribution: Miami; Oneco; West Palm Beach.

Boisduval's Scale

Diaspis boisduvalii Sign.

(Fig. 7)

Scale of Female.—The scale of the female is from 1.2 mm. to 2.2 mm. (4/100 inch to 8/100 inch) in diameter. It is circular in shape and somewhat ovate. It is thin and semitransparent. The color varies from snow-white to light yellow and the scale has a waxy appearance. The exuviae are light yellow or white and are central or subcentral in position.

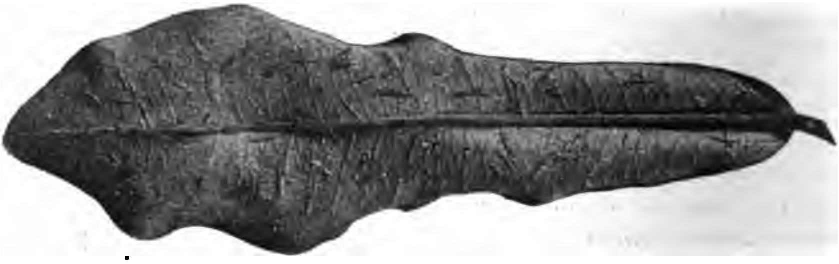

Fig. 6.—Black Thread Scale, *Ischnaspis longirostris* (Sign.), on *Ixora parviflora.* Enlarged slightly. (Original.)

Scale of Male.—The scale of the male is strongly tricarinate, white, more or less massed and is covered with a quantity of curly white hairs.

Plants found infested in Florida: *Latania; Livistona rotundifolia;* orchid; palm; *Phoenix rupicola; Seaforthia; Washingtonia robusta.*

Other plants liable to become infested: *Acacia; Cattleya;* palms; wattle.

Distribution in Florida: Estero; Ft. Myers; Ft. Pierce; Miami; Palm Beach; St. Petersburg; Tampa; West Palm Beach.

CACTUS SCALE

Diaspis echinocacti cacti Comst.

(Fig. 8)

Scale of Female.—The scale of the female is thin and approximately circular. It is of a grayish or greenish-white color. The exuviae are central or subcentral and dark brown in color.

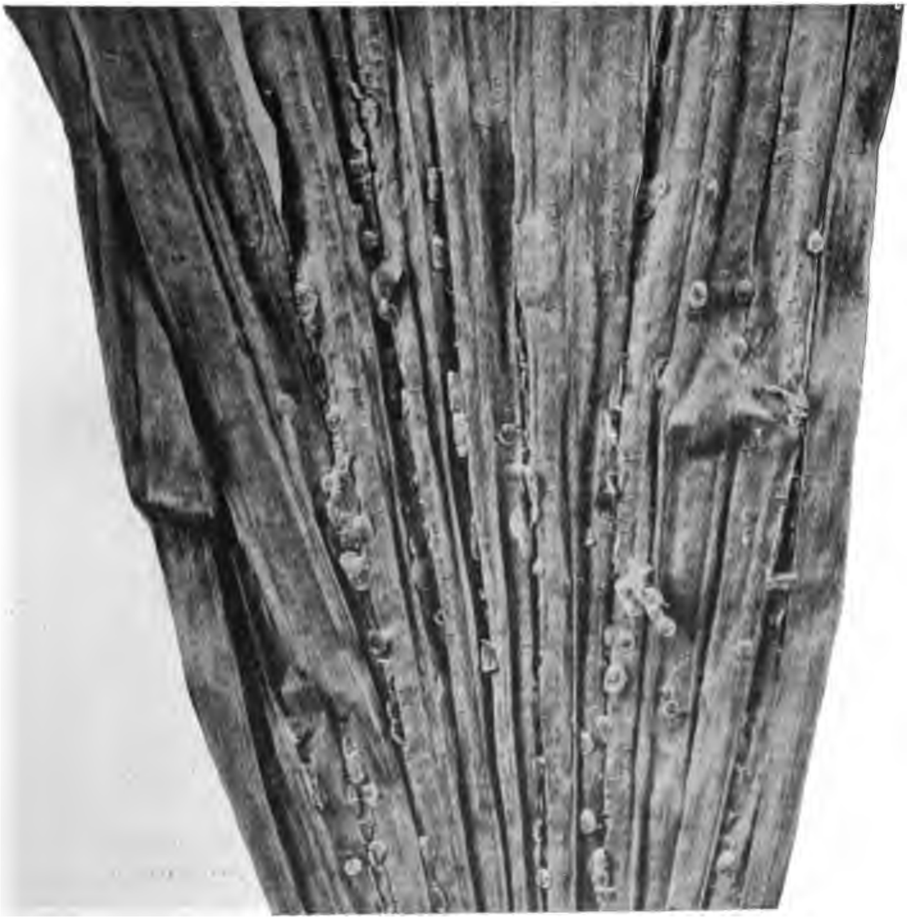

Fig. 7.—Boisduval's Scale, *Diaspis boisduvalii* Sign., on *Livistona rotundifolia*. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is white or light green, and it is oblong and crinate.

Plants found infested in Florida: cactus (*Opuntia* sp.).

Other plants liable to become infested: *Cereus giganteus; Cereus macrogonus;* Echino cactus.

Distribution in Florida: Jacksonville.

Remarks: The only specimens of the cactus scale received were collected by Mr. E. K. Bynum at Jacksonville, Florida.

CALIFORNIA RED SCALE

Chrysomphalus aurantii (Mask.)

(Fig. 9)

Scale of Female.—The scale of the female is 2 mm. in diameter. It is flat and thin and of a light gray color, but the body showing through gives the scale a decidedly reddish or reddish-brown tinge. The exuviae are central.

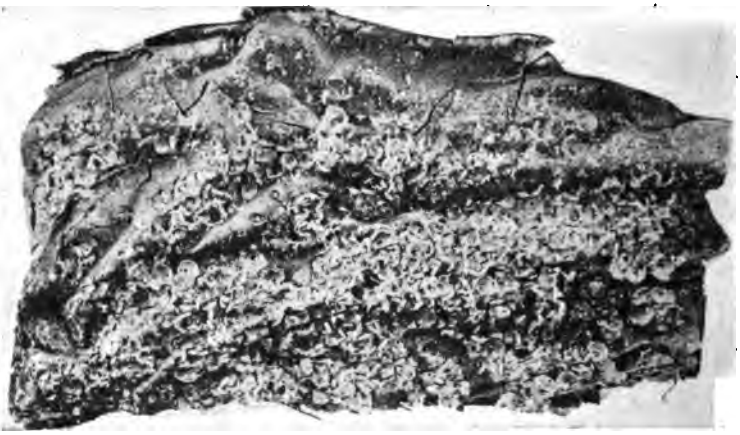

Fig. 8.—Cactus Scale, *Diaspis echinocacti cacti* Comst., on *Opuntia* sp. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is similar to that of the female, but is much smaller and is gray or dark brown in color.

Plants found infested in Florida: citrus; palm.

Other plants liable to become infested: apple; cocoanut; euonymus; fig; grape; lignum-vitae; olive; pear; plum; quince; rose, willow.

Distribution in Florida: Clearwater; Cocoa; Goulds; Largo; Miami; Oakhurst; Ozona; Princeton; Redland; Saint Petersburg; Silver Palm; Sutherland.

CHAFF SCALE

Parlatoria pergandii Comst.

(Fig. 10)

Scale of Female.—The scale of the female is about 1.6 mm. (3/50 inch) in length. It varies from a circular to oblong shape, and is of a dirty gray or brownish-gray color. The exuviae are central or subcentral.

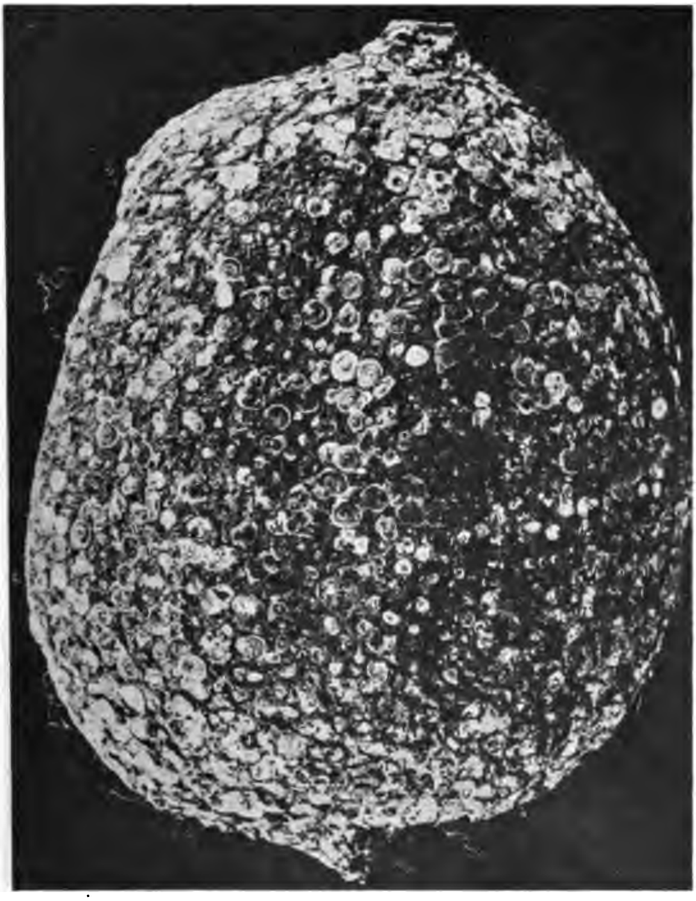

Fig. 9.—California Red Scale, *Chrysomphalus aurantii* (Mask.), on lemon. Enlarged twice. Photograph of specimens received from E. O. Essig, San Diego, Cal. (Original.)

Scale of Male.—The scale of the male is purplish or grayish purple in color. It is smaller than the female, but similar in outline.

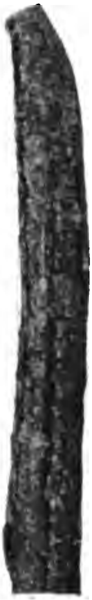

Fig. 10.—Chaff Scale, *Parlatoria pergandii* Comst., on orange. Enlarged twice. (Original.)

Plants found infested in Florida: *Areca;* camphor; *Carissa* sp.; cinnamon; citrus; cocoanut; *Cocos datil; Eugenia; Ficus elastica; Hydriastele wendlandiana;* Italian lemon; japonica; *Jasminum officinale;* mango; oleander; palm; *Phoenix farinifera; Phoenix pumila;* Sago palm; *Seaforthia; Trachycarpus excelsa;* wandering Jew; *Washingtonia robusta.*

Distribution in Florida: Generally distributed over the State.

CHERRY SCALE

Aspidiotus forbesi Johnson

Scale of Female.—The scales of the female are almost circular when not crowded or grouped together. The diameter is about 2 mm. The scale for the most part is convex and ranges from dirty gray to dark gray in color. The exuviae are covered. They are of orange color and are usually subcentral in position.

Scale of Male.—The scale of the male is similar to that of the female, but longer and darker.

Plants found infested in Florida: plum.

Other plants liable to become infested: *Acer pseudoplatanus;* apple; apricot; beech; cherry; *Crataegus;* currant; gooseberry;

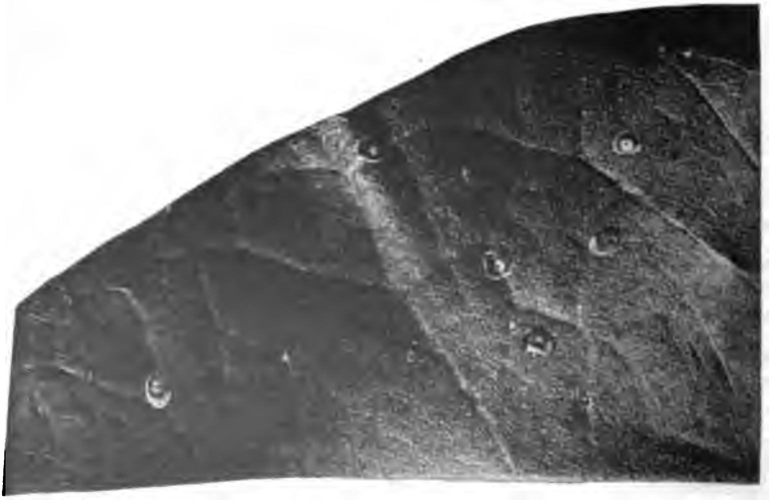

Fig. 11.—*Chrysomphalus agavis* on avocado. Enlarged twice. (Original.)

hawthorne; honey locust; jasmine; peach; pear; quince; walnut.

Distribution in Florida: Macclenny.

Remarks: The specimens of cherry scale received were collected by Mr. F. F. Bibby at Macclenny, Florida.

Chrysomphalus agavis (Towns. & Ckll.)

(Fig. 11)

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter. It is reddish-brown or dark brown in color with the outer margin of the scale light brown. The scale is somewhat flattened and is circular or oblong in shape. The exuviae are central in position and are dark-brown or black in color.

Scale of Male. — The scale of the male is similar to the scale of the female, but smaller and lighter in color.

Plants found infested in Florida: avocado; cabbage palmetto.

Other plants liable to become infested: agave.

Distribution in Florida: Ft. Pierce; St. Cloud.

COCOANUT MEALY BUG
Pseudococcus nipae (Mask.)

Adult Female. — The adult female is small and

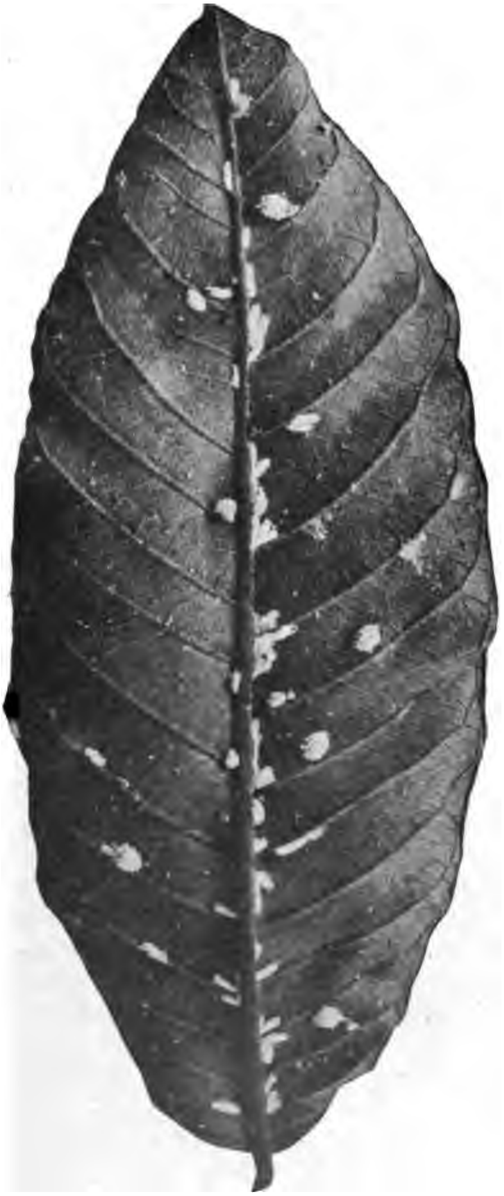

Fig. 12.—Cocoanut Mealy Bug, *Pseudococcus nipae* (Mask.), on guava. Enlarged twice. (Original.)

is covered with compact, thick, yellowish-white wax plates, which project from sides as thick short spines. It is from 1.5 mm. to 3 mm. (3/50 inch to 3/25 inch) in length.

Adult Male.—The adult male is small and yellow.

Plants found infested in Florida: *Anona muricata;* avocado; cabbage palmetto; *Coccolobis;* cocoanut; custard apple; guava; Mammea apple; mulberry; palm; Phoenix palm.

Other plants liable to become infested: *Nipa fruticans;* palms.

Distribution in Florida: Bradentown; Ft. Myers; Ft. Pierce; Gainesville; Homestead; Miami; Oneco; Orlando; Palm Beach; St. Petersburg; West Palm Beach.

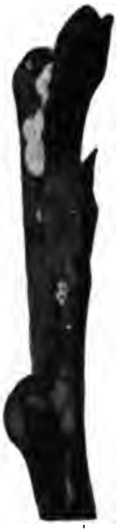

Fig. 18.—Common Mealy Bug, *Pseudococcus citri,* on grapefruit. Slightly enlarged. (Original.)

COMMON MEALY BUG

Pseudococcus citri (Risso)

Adult Female.—The length of the female is from 2.5 mm. to 4 mm. (1/10 inch to 1/4 inch). It is white or yellowish-brown in color. The legs and antennae are brownish. The powdery secretion is slight on the surface of the body. The filaments on the lateral and posterior edges of the body are short, but distinct.

Adult Male.—The adult male is a small, pale, two-winged insect, having two long, white anal filaments.

Plants found infested in Florida: citrus; Lantana; Lantania; mastic; palmetto; potato; ragweed; royal palm (roots).

Other plants liable to become infested: *Acalypha; Bignonia;* bottle-brush; *Bouvardia; Callistemon lanceolatus;* citron; *Cestrum;* coffee; coleus; cotton deer-brush; English ivy; ferns; fuchsia; geranium; Guadaloupe palm; grape; *Ipomoea;* ivy; leadwort; moonflower; nettle; nightshade; oleander; passion vine; peony; poinsettia; potato; pumpkin; redwood; *Rex bignonia; Solanum jasminoides;* tobacco; umbrella plant; wandering Jew.

Distribution: Distribution is general over the State.

Conchaspis angraeci Ckll.

(Fig. 14)

Scale of Female.—The scale of the female is approximately circular and somewhat conical. The apex is bluntly pointed and the margins are broad and flat. Six or eight ridges radiate from the apex, but part disappear before reaching the margin. The color is white or grayish-white. The scale is from 2 mm. to 2.5 mm. in diameter.

Plants found infested in Florida: *Acalypha;* fig; hibiscus; holly; *Pittosporum; Tabernae montana;* wisteria.

Other plants liable to become infested: *Angraecum; Rodriguezia secunda.*

Distribution in Florida: Clearwater; Miami; Palm Beach; Tampa.

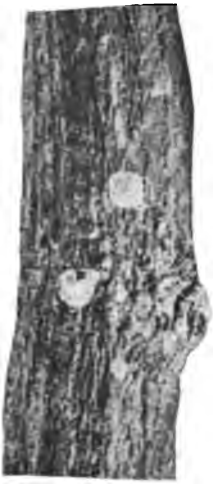

Fig. 14.—*Conchaspis angraeci* Ckll., on *Acalypha*. Enlarged twice. (Original.)

THE COTTONY COCHINEAL INSECT
Dactylopius confusus (Ckll.)

Adult Female.—The adult female is easily recognized by large flocculent masses of thick, white, cottony or waxy material, which is secreted as a covering for the body of the female. The body of the female is red and when crushed yields a bright crimson colored fluid. The length of the scale is from 3 mm. to 6 mm.

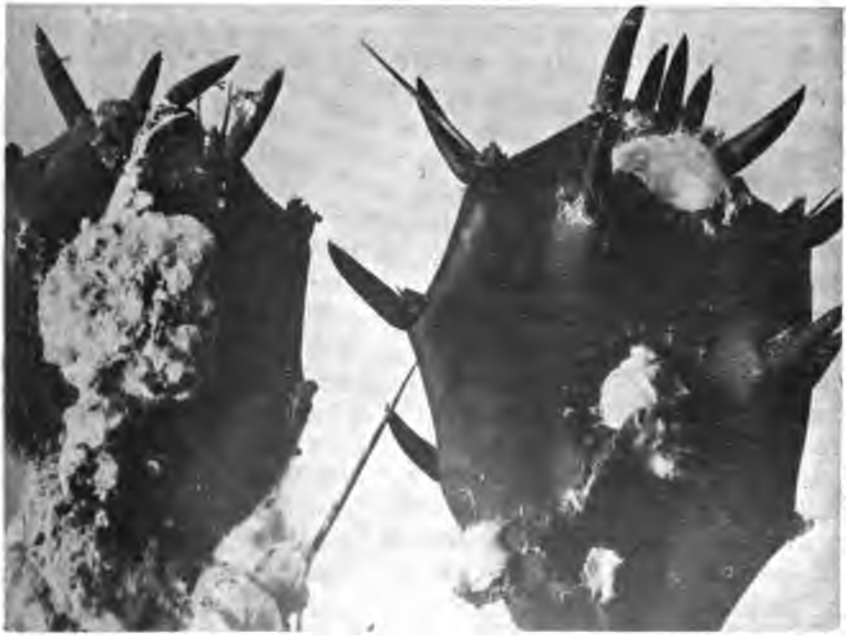

Fig. 15.—The Cottony Cochineal Insect, *Dactylopius confusus* (Ckll.), on *Opuntia*. Enlarged twice. (Original.)

Adult Male.—The adult male is similar to the female. The cocoons are snow white and are usually massed with females.

Plants found infested in Florida: cactus *(Opuntia)*.

Other plants liable to become infested: *Echinocactus.*

Distribution: Citra; Crooked Lake; Gainesville; Lynn; Maitland; Sebring.

COTTONY CUSHION—, OR FLUTED, SCALE

Icerya purchasi Mask.

(Fig. 16)

Adult Female.—Mature females have large, white, fluted, cottony egg masses at the posterior end of the red, yellowish or dark brown bodies. The eggs are deposited in the cottony mass.

Adult Male.—The adult male is a small, two-winged, red-bodied insect, having long antennae.

Plants found infested in Florida: citrus; cowpeas; guava; myrtle; rose; wild bamboo; wormwood.

Other plants liable to become infested: *Acacia;* alfalfa; *Amaranthus; Ambrosia;* apple; apricot; *Artemisia ludoviciana;* Australian black wood; Australian pine; banyan; Bermuda grass; *Bidens pilosa;* bottle brush; *Bougainvillea;* box wood; bridal wreath; *Carex* sp.; castor bean; cedar of Lebanon; *Cenchrus; Chenopodium* sp.; *Chrysanthemum; Chrysolidocarpus lutescens;* cocoanut palm (nuts only); coleus; cork elm; cypress; dwarf box; dwarf flowering almond; English ivy; English walnut; *Epilobium coloratum; Erigeron canadensis;* fig; fish-tail palm *(Caryota urens)*; flowering almond; foxtail grass; geraniums; golden rod; grape; grass; gumbo limbo; hackberry; hawthorne; *Helianthus* sp.; ironweed; knot weed; lambs-quarter; laurel; locust; loggerhead breast; magnolia; *Malva rotundifolia; Medicago denticulata;* mulberry; nettle; nightshade; oak; oleander; *Panicum crus-galli; Paspalum* sp.; peach; pear; pecan; pepper; peppermint; pigweed; pine; *Pittosporum; Plantago* sp.; plumbago; poinsettia; *Polygonum;* pomegranate; *Portulaca olearacea;* potato; purslane; quince; ragweed; rose de Montana; rose geranium; rosemary; royal poinciana; *Rumex crispus; Sapodilla;* shepherd's needle; *Sidum* sp. (stone crop); smilax; *Solanum douglasii; Solidago; Sonchus oleraceus;* Spanish lime; Spanish mulberry; spearmint; *Stachys aequata;* strawberry; sunflower; sweet gum; verbena; veronia; walnut; white oak; wild greasewood; willow.

Distribution in Florida: Alturas; Ashton; Auburndale; Avon

Park; Bartow; Blanton; Bowling Green; Bradentown; Brewster; Brownville; Buchanan; Clearwater; Cocoanut Grove; Crooked Lake; Crystal River; Dade City; Davenport; Dover; Dundee; Dunedin; Eagle Lake; Elfers; Eloise; Eustis; Fellsmere; Florence Villa; Ft. Green; Ft. Green Springs; Ft. Meade; Ft. Myers; Ft. Pierce; Frostproof; Glenwood; Gordonville; Haines City; Indian Rocks; Inverness; Kathleen; Key West; Kissimmee; Knights; Kuhlman; Lake Alfred; Lake Gem; Lake Hamilton; Lakeland; Lake Wales; Lake Weir; Largo; Leesburg; Limona; Lutz; Lynne; Magdalene; Manatee; Mango; Miami; Narcossee;

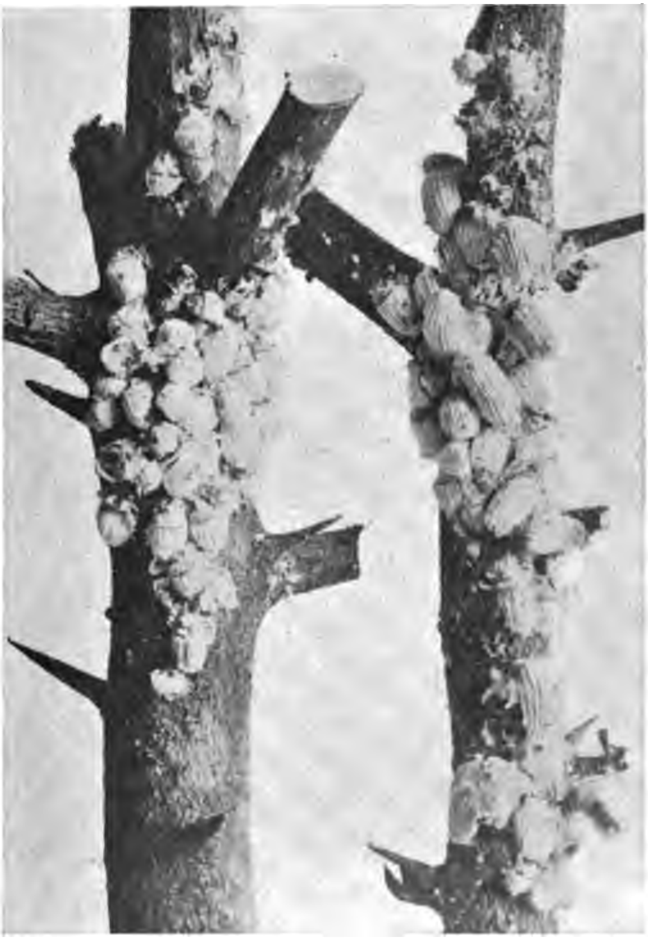

Fig. 16.—Cottony Cushion—, or Fluted, Scale, *Icerya purchasi* Mask., on grapefruit. Natural size. (Original.)

Nocatee; Odessa; Oneco; Ozona; Palm City; Palmetto; Parrish; Pensacola; Plant City; Plymouth; Riley; Riverview; Safety Harbor; St. Cloud; St. Petersburg; San Antonio; Sebring; Seffner; Seminole; Shell Beach; Socrum; Stuart; Sutherland; Tampa; Tangerine; Tavares; Terra Ceia; Thonotosassa; Umatilla; Valrico; Wauchula; Waverly; White City; Wiersdale; Wimauma; Windermere; Winter Garden; Winter Haven; Winter Park; Yalaha; Zolfo.

Remarks: Most of the specimens of cottony cushion-scale received during the months of July and August were severely infested with two scale-eating moths, *Laetilia coccidivora* and *Pyroderces rileyi*.

COTTONY MAPLE SCALE

Pulvinaria vitis Linn.

Adult Female.—The length of the female is from 4 mm. to 6 mm. (about ¼ inch). The color varies from light to dark brown. It is oblong in shape, convex and the surface is transversely wrinkled. The egg-sac is secreted posteriorly and is composed of a cottony material.

Plants found infested in Florida: Boston ivy; pecan; wild grapevine.

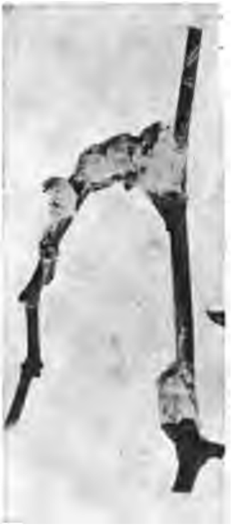

Fig. 17.—Cottony Maple Scale, *Pulvinaria vitis* (Linn.), on wild grape. Natural size. (Original.)

Other plants liable to become infested: alder; apple; blackberry; box-elder; boxwood; buckeye; citrus; currant; elms; euonymus; gooseberry; hackberry; hawthorne; lilac; linden; locust; maples; mountain ash; mulberry; oak; osage orange; peach; pear; plum; poplar; quince; rose; sarsaparilla; *Spiraea;* sumac; sycamore; *Viburnum;* willow; woodbine.

Distribution in Florida: Brooksville; City Point; Gainesville; Hawthorne; Palatka.

THE CYANOPHYLLUM SCALE

Aspidiotus cyanophylli Sign.

Scale of Female.—The scale of the female is circular to ovate in outline. It is from 1.5 mm. to 2 mm. in diameter, and of a brownish-yellow or pinkish color. The exuviae are central in position and bright yellow in color, often with a nipple-like mass of white excretion.

Scale of Male.—The scale of the male is similar to that of the female, but the exuviae are subcentral and the outline elliptical.

Plants found infested in Florida: hammock bay.

Other plants liable to become infested: *Cinchona; Cyanophyllum; Cycas revoluta; Ficus indica; Ficus laurifolia; Ipomoea; Laurus;* moonflower; orchids; palms; *Pritchardia filifera;* tea.

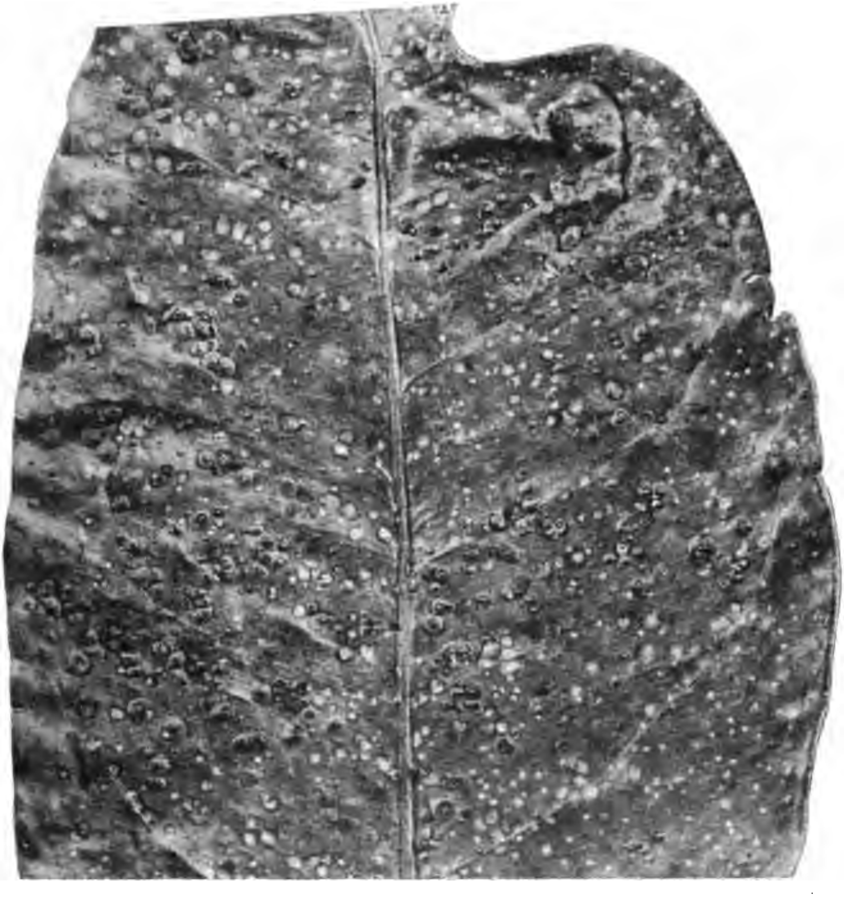

Fig. 18.—Dictyospermum Scale, *Chrysomphalus dictyospermi* (Morg.), on orange. Enlarged twice. Photographed from specimens collected in Spain by Prof. H. H. Hume. (Original.)

Distribution in Florida: Sebring; West Palm Beach.

Remarks: The specimens of *Aspidiotus cyanophylli* Sign. from West Palm Beach, on hammock bay, collected by Mr. F. F. Bibby.

DICTYOSPERMUM SCALE

Chrysomphalus dictyospermi (Morg.)

Scale of Female.—The scale of the female is from 1.25 mm. to

2 mm. in diameter. It is slightly convex and varies from grayish-white to brown in color. The exuviae are central or subcentral and light yellow or orange in color. The central nipple is grayish, surrounded by a dark depressed area.

Scale of Male.—The scale of the male is similar to that of the female, but is more elongated. The exuviae are subcentral.

Plants found infested in Florida: apollo laurel; *Arbor vitae;* avocado; banana; Barbados cherry *(Malpighia glabra); Camellia japonica; camphor;* century plant; Chinese fan palm; cinnamon; citrus; cocoanut; creeping cypress; *Ficus altissima; Ficus eburnia; Ficus elastica;* guava; *Jasminum officinale; Kentia belmoreana;* Kenyon palm; mango; Panama hat plant; *Pandanus;* pecan; Phoenix palm; poinsettia; privet; *Rheedia aristata;* rose; royal palm; *Sabal blackburniana; Sabal havanensis;* Sago palm.

Other plants liable to become infested: *Cycas; Dictyospermum album; Erythrina indica; Latania.*

Distribution in Florida: Clearwater; Fort Pierce; Gainesville; Homestead; Jacksonville; Key West; Larkin; Miami; Ocala; Oneco; Orlando; Palm Beach; Pensacola; Saint Leo; Sarasota; Sebring; Tampa.

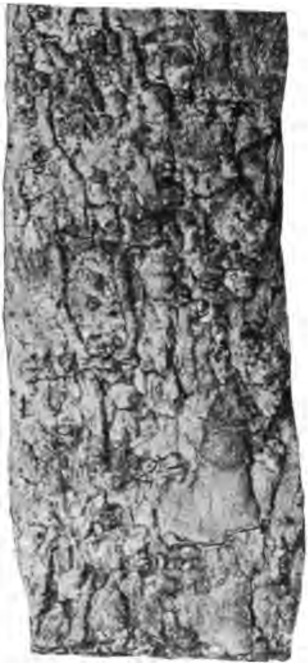

Fig. 19.—English Walnut Scale, *Aspidiotus juglans-regiae* Comst., on *Liquidamber styraciflua.* Enlarged twice. (Original.)

ENGLISH WALNUT SCALE
Aspidiotus juglans-regiae Comst.

Scale of Female.—The scale of the female is flattened and circular and is from 2.5 mm. to 3 mm. in diameter. The color varies from light gray, on English walnut, to dark reddish brown or black when on plum or peach. The color so harmonizes with the bark in some cases as to make it difficult to distinguish. The exuviae are central or subcentral and covered with a secretion.

Scale of Male.—The scale of the male is like that of the female, but more elongated and smaller. The exuviae are, for the most part, at or near the anterior end.

Plants found infested in Florida: English walnut; peach; plum; tulip poplar.

Other plants liable to become infested: apple; elm, hackberry, prickly ash; rose; sweet gum; white ash.

Distribution in Florida: Bellair; Dade City; Gainesville; Lutz; Olustee; Oneco; Tampa.

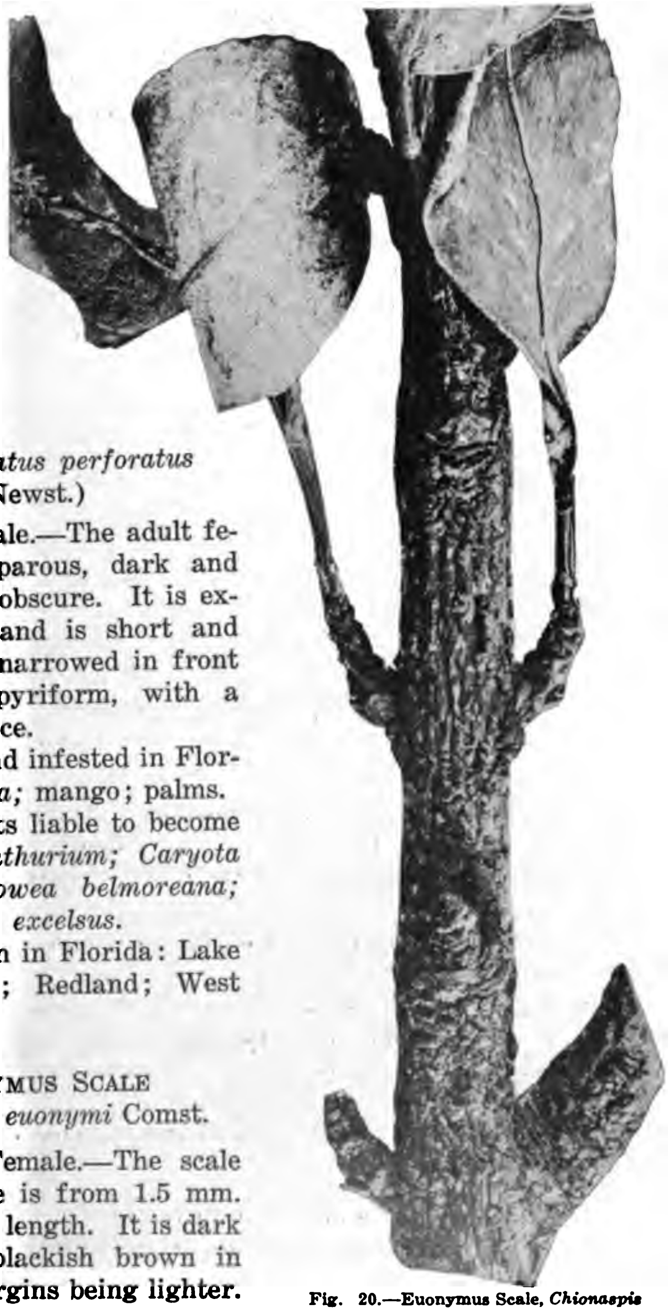

Fig. 20.—Euonymus Scale, *Chionaspis euonymi* Comst., on *Euonymus*. Enlarged twice. (Original.)

Eucalymnatus perforatus (Newst.)

Adult Female.—The adult female is viviparous, dark and more or less obscure. It is extremely flat and is short and ovate. It is narrowed in front or broadly pyriform, with a shining surface.

Plants found infested in Florida: *Eugenia;* mango; palms.

Other plants liable to become infested: *Anthurium; Caryota cumingii; Howea belmoreana; Trachycarpus excelsus.*

Distribution in Florida: Lake City; Miami; Redland; West Palm Beach.

EUONYMUS SCALE
Chionaspis euonymi Comst.

Scale of Female.—The scale of the female is from 1.5 mm. to 2.2 mm. in length. It is dark grayish or blackish brown in color, the margins being lighter. It is broadened posteriorly.

Scale of Male.—The scale of the male is white. It is tricarinate and smaller than the female.

Plants found infested in Florida: *Euonymus japonicus.*

Other plants liable to become infested: *Celastrus scandens; Euonymus atropurpureus; Euonymus europaeus; Euonymus latifolia;* orange.

Distribution in Florida: Pensacola.

EUROPEAN FIORINIA

Fiorinia fioriniae (Targ.)

Scale of Female.—The scale of the female is thin, transparent and brownish yellow in color. The sides, which are almost parallel, are elongated, hard and chitinous. The diameter is from 1 mm. to 1.25 mm. (1/25 inch to 1/16 inch).

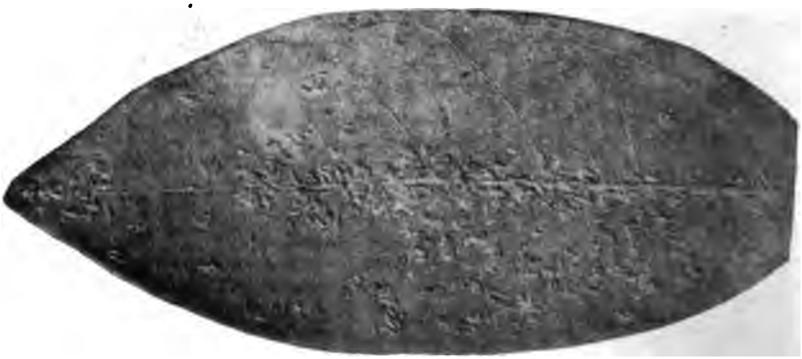

Fig. 21.—The European Fiorinia, *Fiorinia fioriniae* (Targ.), on hammock bay. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is similar to that of the female, but smaller.

Plants found infested in Florida: *Camellia japonica;* hammock bay.

Other plants liable to become infested: *Anthurium acaule; Areca aurea;* camellia; cocoanut palm; *Cupressus; Cycas revoluta;* ferns; *Ficus; Hedera helix; Leptospermum; Livistona; Phytelephas macrocarpa; Podocarpus.*

Distribution in Florida: Jacksonville; Oneco; Tallahassee; West Palm Beach.

FLORIDA RED SCALE

Chrysomphalus aonidum (Linn.)

(Fig. 22)

Scale of Female.—The scale of the female is circular and

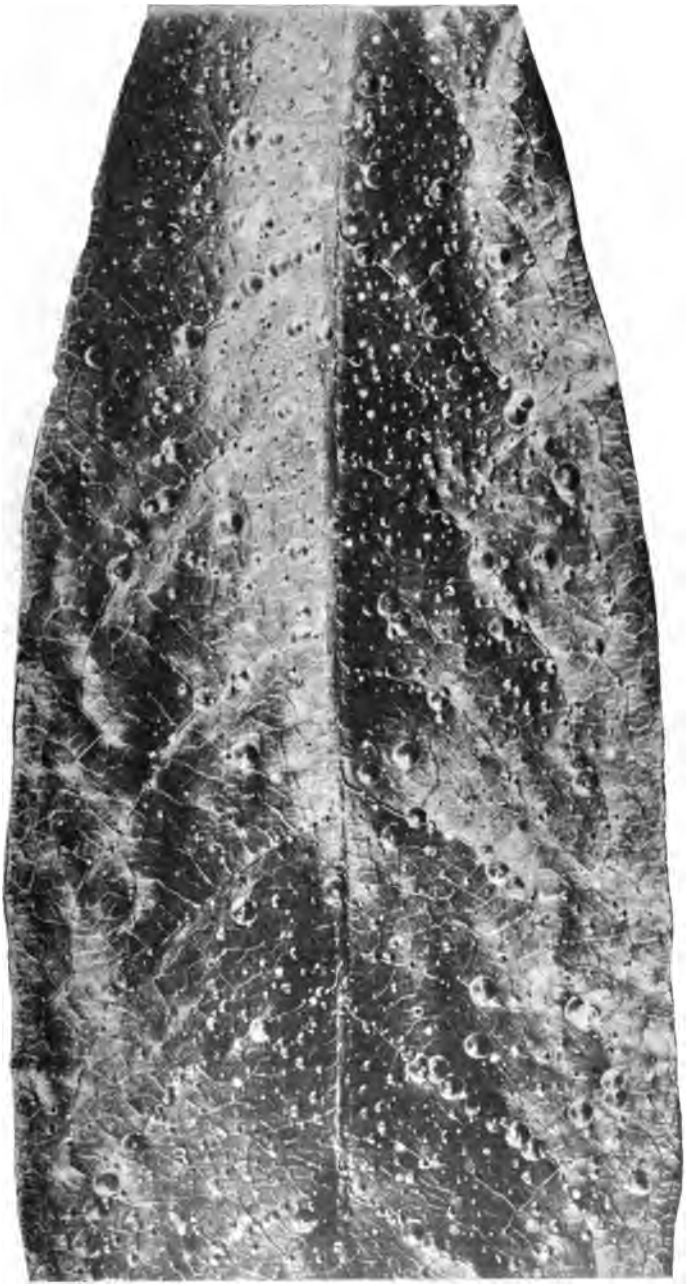

Fig. 22.—Florida Red Scale, *Chrysomphalus aonidum* (Linn.), on *Arbytritus*. Enlarged twice. (Original.)

convex. In color it is dark reddish-brown to almost black. The exuviae are central, bright yellow in color and form a central, grayish-white nipple.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and lighter in color.

Plants found infested in Florida: apollo laurel; *Aralia; Areca aliceae; Areca triandra;* Australian plum; avocado; camphor; *Cedrela odorata; Chamaedorea;* cherry laurel; cinnamon; citrus; *Cocos plumosa; Dictyosperma album; Dictyosperma rubrum; Dypsis madagascariensis; Eucalyptus; Ficus elastica;* German ivy; guava; *Hyophorbe;* jasmine; *Kentia fostercana; Latania;* magnolia; Mammea apple; mango; mulberry; oleander; palm; *Pandanus; Phoenix cananensis;* pecan; poinsettia; ponderosa lemon; privet; *Rhyncospernum; Roscheria melanochaetes;* rose; royal palm; sago palm; *Seaforthia;* screw-pine; sour sop; sweet olive; traveler's tree; *Washingtonia robusta.*

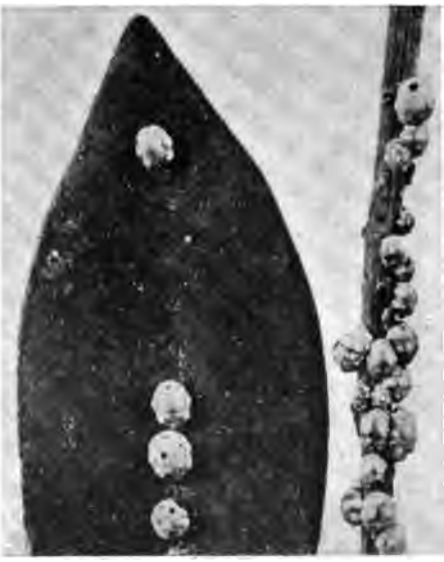

Fig. 28.—Florida Wax Scale, *Ceroplastes floridensis* Comst., on bay. Enlarged twice. (Original.)

Plants liable to become infested: Begonia; camellia; *Ilex latifolia;* rhododendron.

Distribution in Florida: Generally distributed over the State.

Florida Wax Scale

Ceroplastes floridensis Comst.

Adult Female.—The adult female is from 2.5 mm. to 3 mm. in length. It is covered by a waxy excretion. The color is usually brownish on the dorsal surface and dirty white, yellowish white or brownish on the sides.

Plants found infested in Florida: apple; avocado; box wood; cape jasmine; cherry laurel; Chinese holly; cinnamon; citrus; *Coccolobis; Cryptostegia; Euonymus;* fern; *Ficus aurea; Ficus elastica;* French mulberry; gall berry; *Gordonia lasianthus;*

guava; Japan plum; loquat; mango; myrtle; oleander; peach; pine; Pittosporum; plum; quince; red bay; sweet potato; tea; *Triplaris*.

Plants liable to become infested: *Andromeda; Anona reticulata; Anthurium; Ilex glabra; Magnolia fuscata;* pomegranate.

Distribution in Florida: Generally distributed over the State.

THE GLOOMY SCALE

Chrysomphalus tenebricosus (Comst.)

Scale of Female.—The scale of the female is 1.5 mm. in diameter. It is circular, very convex and of a dark gray color, resembling the bark on which it rests. The surface of the scale is rough. The exuviae are central and are surrounded by a gray ring.

Scale of Male.—The scale of the male is similar to that of the female, but oval. The exuviae are near the anterior end.

Host plants found infested in Florida: *Acer rubrum;* gall berry.

Plants liable to become infested: apple; box elder; cottonwood; hackberry; mulberry; oak; poplar; silver maple.

Distribution in Florida: Fort Pierce; Macclenny.

Remarks: The specimens of *Chrysomphalus tenebricosus* (Comst.) were collected by Mr. F. F. Bibby.

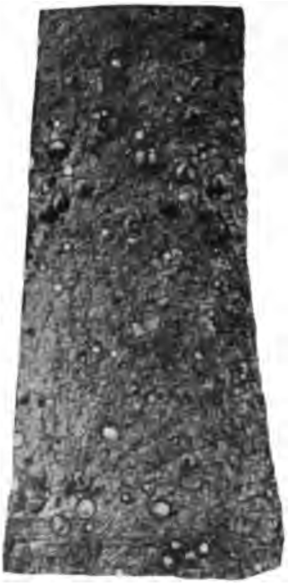

Fig. 24.—The Gloomy Scale, *Chrysomphalus tenebricosus* (Comst.), on *Acer rubrum*. Slightly enlarged. (Original.)

THE GRAPE SCALE

Aspidiotus uvae Comst.

(Fig. 25)

Scale of Female.—The scale of the female is from 1.5 mm. to 2 mm. in diameter. The scale is nearly circular, quite flat and thin. In color the scale is light brown or light yellowish-brown, and rather conspicuous, because of the darker color of the grape vine. The exuviae are light yellow in color and subcentral in position. The ventral scale is thin and adheres to the bark when the insect is removed.

Scale of Male.—The scale of the male is slightly darker in color than the female. It is elongated and has the exuviae near one end.

Plants found infested in Florida: grape; hickory.

Distribution in Florida: Macclenny.

Remarks: The only specimens of *Aspidiotus uvae* received were collected by Mr. E. K. Bynum at Macclenny, Fla.

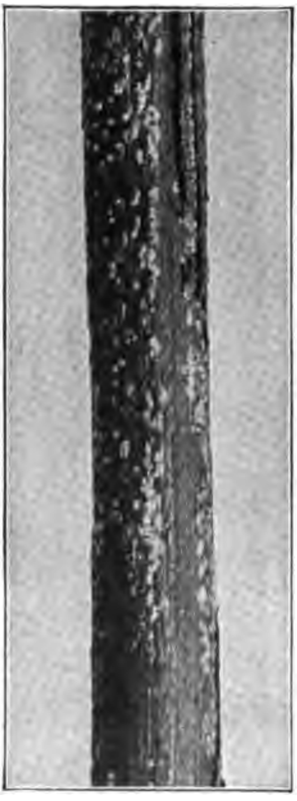

Fig. 25.—The Grape Scale, *Aspidiotus uvae* Comst., (from the 8th Ann. Rept. State Entomologist of Indiana, p. 305.)

GREEDY SCALE

Aspidiotus camelliae (Sign.)

(Fig. 26)

Scale of Female.—The scale of the female is about 3-50ths inch (1.5 mm) in diameter. It is thin and convex and gray or blackish in color. The exuviae are subcentral and dark brown or black in color.

Scale of Male.—The scale of the male is similar to that of the female, but not so convex. It is more elongated and smaller.

Plants found infested in Florida: avocado; bay; camphor; cherry laurel; *Euonymus japonicus;* guava; *Magnolia grandiflora; Melia azadarach;* morning glory; palm; *Plumiera;* privet; water oak.

Other plants liable to become infested: *Acacia;* almond; apple; birch; buck bush; *Camellia;* camphor; *Cercis;* cherry; *Cissus; Coprosma;* cottonwood; English ivy; English walnut; eucalyptus; fig; *Fuchsia; Genista;* grape; heath; holly; honey-locust; laurel; *Lavatera;* lemon; maple; mistletoe; mountain holly; *Myoporum;* myrtle; nightshade; olive; orange; passion vine; pear; pepper tree; *Pittosporum;* pomegranate; quince; redbud; *Rhamnus crocea;* rose; sage; *Sedum;* silver tree; *Strelitzia;* tea; walnut; willow; yam.

Distribution in Florida: Cocoanut Grove; Ft. George; Ft. Pierce; Gainesville; Glen St. Mary; Oneco; West Palm Beach.

GREENHOUSE ORTHEZIA

Orthezia insignis Douglas

(Fig. 27)

Adult Female: The body of the adult female is broadly oval, having a width of about 1.5 mm. to 2 mm. The length is about 1.5 mm. It is usually dark green in color, but older specimens become blackish. With the exception of the head it is surrounded by a marginal series of snow-white lamellae or waxy plates. These plates increase in length posteriorly and point backward, with the exception of the first three on each side. The antennae have eight joints. The legs are light brown and bear numerous spines.

Plants found infested in Florida: iron weed.

Other plants liable to become infested: *Achillae; Ageratum; Bignonia; Capsicum;* chrysanthemum; citrus; coleus; *Cuphea; Gardenia; Ipomoea;* ironweed; *Lantana; Lonicera;* moonflower; pepper; pigweed; sage; *Salvia;* strawberry; *Strobilanthes;* tea; *Thunbergia;* tomato; verbena; *Vernonia;* yarrow.

Distribution in Florida: Oneco.

Remarks: This species is a very serious greenhouse pest. The specimens of *Orthezia insignis* were collected by F. W. Poos, Jr., at Oneco, Fla.

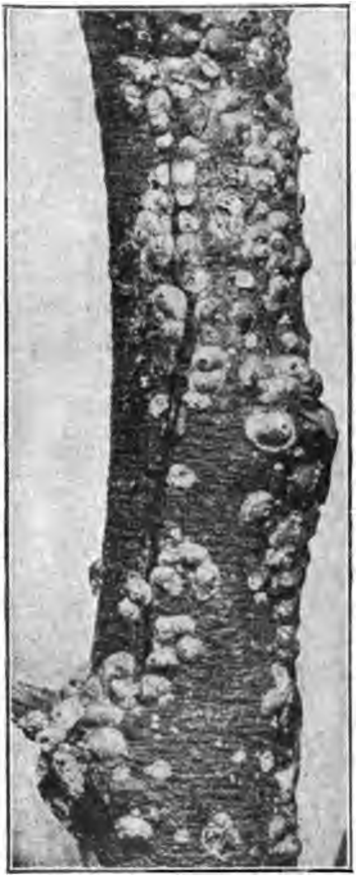

Fig. 26.—The Greedy Scale, *Aspidiotus camelliae* (Sign.) (After Essig., Injurious and Beneficial Insects of California.)

GREEN SHIELD SCALE

Pulvinaria psidii Mask.

(Fig. 28)

Adult Female.—The adult female is ovoid, convex above and elevated behind by a cottony egg-sac, which eventually projects

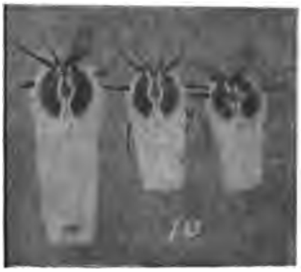

Fig. 27.—The Greenhouse Orthezia, *Orthezia insignis* Dougl. (After Sanders, Journ. Ec. Ent. Vol. II.)

on all sides. It is green in color and more or less obscured by a white, powdery secretion. The length of the scale is from 2 mm. to 4 mm. (1/12 inch to 1/6 inch).

Plants found infested in Florida: *Antidesma;* Australian silk oak; avocado; cape jasmine; citrus; *Clerodendrum; Coccolobis; Cupani sapidia; Ficus aurea; Ficus australis; Ficus benjamina; Ficus elastica; Ficus indica; Ficus macrophylla;* fiddle-wood; guava; hibiscus; *Macrophylla;* mango; mastic; *Nephelium longanum;* rose apple; *Sapodilla;* sea grape; *Solonum* sp., *Warneria thunbergia;* wax myrtle; yellow elder.

Other plants liable to become infested: *Eurya japonica;* ferns; *Pittosporum;* plum.

Distribution in Florida: Arch Creek; Bradentown; Cocoanut Grove; Fort Myers; Fort Pierce; Homestead; Little River; Miami; Oneco; Palm Beach; Pompano; St. Petersburg; Sebring; West Palm Beach.

GROUND PEARL
Margarodes formicarium Guilding

Adult Female.—The adult female is enclosed in a globular horny shell, and resembles a small pea

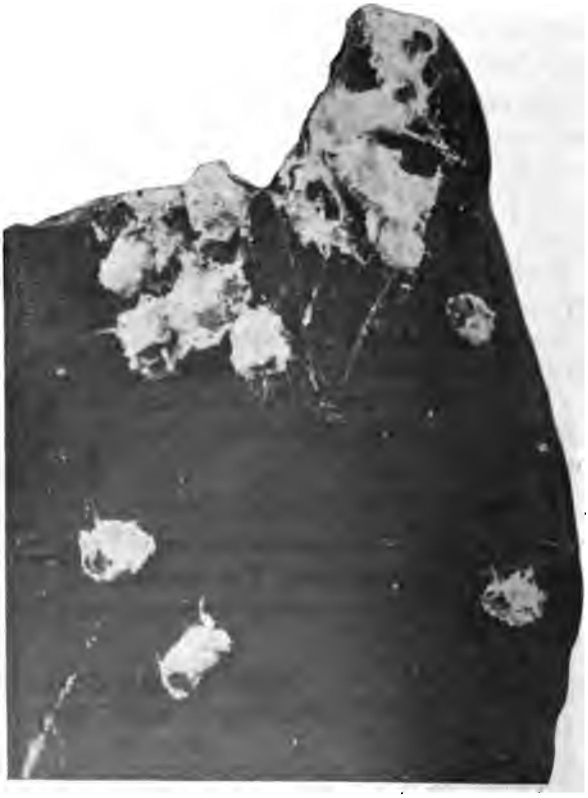

Fig. 28.—Green Shield Scale, *Pulvinaria psidii* Mask., on *Ficus aurea.* Enlarged twice. (Original.)

in shape and size. In color, it is a light yellowish-brown. The general appearance resembles a pearl. It is usually found on roots of plants near an ant's nest.

Plants liable to be found infested: corn; sugar cane and allied plants.

Distribution in Florida: Key Largo.

Remarks: This scale has not been received by the author, but was reported from Key Largo in 1907.

HEMISPHAERICAL SCALE

Saissetia hemisphaerica (Targ.)

Adult Female.—The adult female is from 2 mm. to 3 mm. (about 1/8 inch to 3/16 inch) in diameter. The color varies from light to dark brown. The scale is more or less hemisphaerical in shape, convex on dorsal surface, smooth and shining.

Plants found infested in Florida: *Arbor vitae;* asparagus fern; avocado; *Claucera lausium; Cycas;* fern; *Jacaranda mimisaefolia; Lagerstroemia;* oleander; *Philibertella clausa; Prosopis juliflora; Rheedia aristata; Rheedia edulis;* Sago palm; *Tabernae montana; Zamia.*

Other plants liable to become infested: *Aloe:* asparagus; *Begonia; Camellia;* chrysanthemum; citrus; *Cocos; Croton variegatum; Ficus;* guava; mountain holly; orchids; palms; peach; pepper tree; rose.

Distribution in Florida: Ft. Myers; Gainesville; Homestead; Lake Wales; Oneco; Redland; Rockledge; St. Petersburg; Silver Palm; Tampa; West Palm Beach.

HEMLOCK SCALE

Aspidiotus abietis (Schr.)

Scale of Female.—The scale of the female is from 1/20 inch to 2/25 inch (1.3 mm. to 2 mm.) in length. The scale is elongated and the sides are almost parallel, the ends being rounded. The exuviae is orange color and the color of the scale is dark gray or black with the margins lighter.

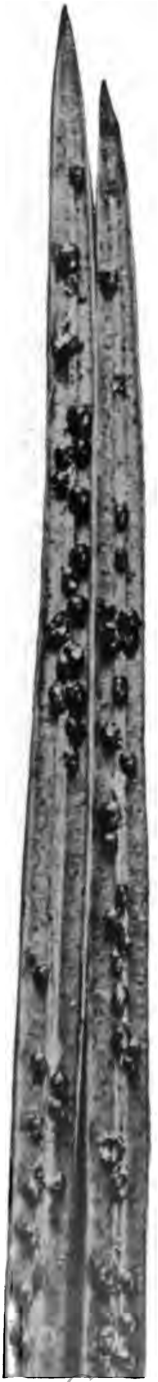

Fig. 29.—Hemisphaerical Scale, *Saissetia hemisphaerica* (Targ.), on Sago palm. Slightly enlarged. (Original.)

Scale of Male.—The scale of the male is similar to that of the female, but is smaller and slightly darker.

Plants found infested in Florida: short leaf pine.

Other plants liable to become infested: fir; hemlock; maple; pines.

Distribution in Florida: West Palm Beach.

Remarks: This species was collected by Mr. F. F. Bibby, near West Palm Beach, Florida.

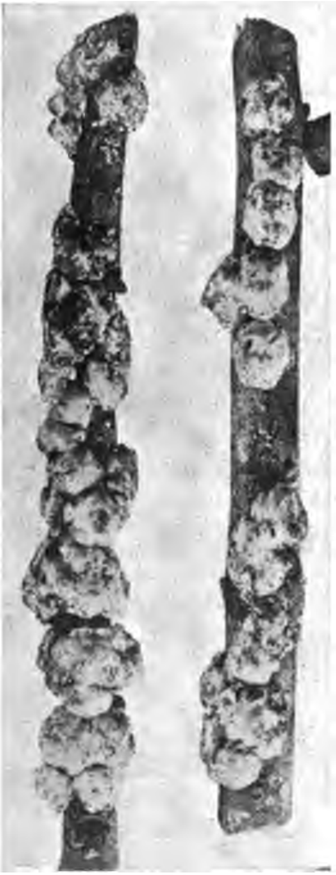

Fig. 30.—Japanese Wax (or Mexican Wax). Scale, *Ceroplastes ceriferus* (Anderson), on persimmon. Enlarged twice. (Original.)

JAPANESE WAX SCALE

Ceroplastes ceriferus (Anderson)

Scale of Female.—The diameter of the scale of the female is from 3 mm. to 5 mm. The bodies are covered with a thick, white wax that gives a greasy appearance. The body is black or purplish brown and is indistinctly seen through the wax.

Scale of Male.—The scale of the male is from 2 mm. to 2.5 mm. in length. It is opaque and glassy white.

Plants found infested in Florida: gumbo limbo; wild persimmon.

Other plants liable to become infested: *Camellia; Gardenia;* hibiscus; mango; *Melaleuca;* Myrica cerifera; orange; tea.

Distribution in Florida: Dundee; West Palm Beach; Winter Haven.

Remarks: Specimens of *Ceroplastes* collected at West Palm Beach, Florida, were severely infested with *Laetilia coccidivora.*

Kermes galliformis Riley

"A large dark dirty-gray form, which turns to a nearly white color when exposed a season on the twigs. Female scale 6 mm. long, 7 mm. broad, 6 mm. high, with black spots, and viewed with a hand-lens, the scale is seen to be covered with minute black specks. Newly hatched larvae dirty-gray."

Plants found infested in Florida: live oak.

Other plants liable to become infested: white oak.

Distribution in Florida: Bradentown; Gainesville; Tampa; West Palm Beach.

Remarks: The above description is taken from King (Psyche IX, p. 79, 1900).

Lataniae Scale
Aspidiotus lataniae Sign.

Scale of Female.—The scale of the female is almost circular when found singly, but is rather irregular and elongated in form when clustered together. The diameter is from 1.5 mm. to 2 mm. It is convex and the color varies from light yellow to dirty white, the central portion being dark. The exuviae are large, central or subcentral in position and pale brown or yellow in color.

Scale of Male.—The scale of the male is similar to that of the female in color, but is smaller and elongated.

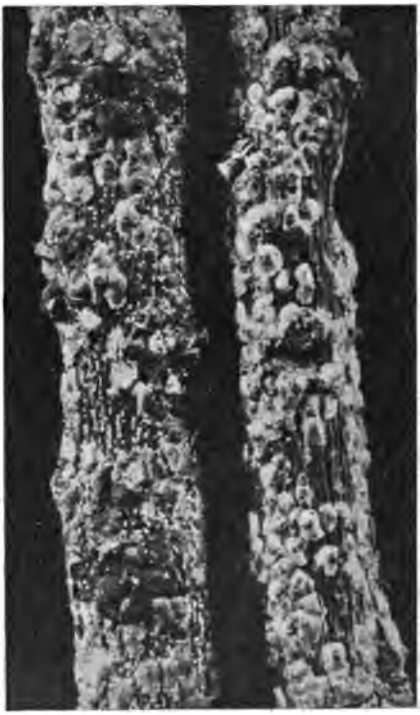

Fig. 31.—Lataniae Scale, *Aspidiotus lataniae* Sign., on chinaberry (*Melia azadarach.*) Enlarged twice. (Original.)

Plants found infested in Florida: *Artocarpus;* avocado; bamboo briar; camphor; cherry laurel; chinaberry; cinnamon; cocoanut; *Cocos bonneti; Ficus* sp.; gall berry; guava; juniper; loquat; mango; matrimony vine; *Melaleuca nesophila;* palm; pecan; persimmon; poison ivy; quince; rose; sweet gum; sweet olive; witch hazel.

Other plants liable to become infested: *Areca lutescens;* cottonwood; *Scalesia.*

Distribution in Florida: Apalachicola; Astatula; Avon Park; Bradentown; Clearwater; Cocoanut Grove; Ft. Myers; Ft. Pierce; Gainesville; Glen St. Mary; Inverness; Jacksonville; Lakeland; Macclenny; Miami; Oneco; Orlando; Palatka; Palm Beach; Pensacola; Redland; Sebring; Tallavast; Tampa; West Palm Beach.

Lecaniodiaspis tessellatus Ckll.

“Female.—Scale nearly circular, moderately convex; long. 4½, lat. 4, alt. 2 mm.; above dull red-brown, not very dark with dull white secretion forming lines, indistinct in middle, but at the sides forming regular pentagons, with an oval or elongate medium patch in each, arising from the margin of the scale. These pentagonal areas are eleven in number on each side, they are pointed mesad, the two shortest sides being the mesad ones, and the lateral side being formed by the margin of the scale. The lines of secretion indicate, but do not complete, three dorsal rows of enclosed areas, thus five rows in all. The enclosed areas are quite flat, not raised into little tubercles as in some species.”

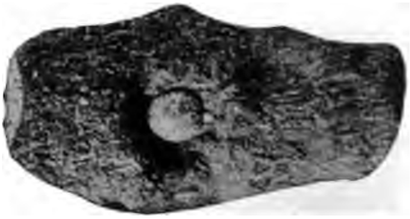
Fig. 32.—*Lecaniodiaspis tessellatus* Ckll., on hickory. Enlarged twice. (Original.)

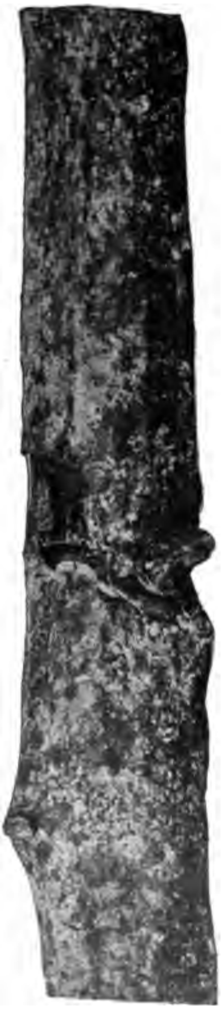
Fig. 33.—*Lepidosaphes alba* (Ckll.), on *Manihot aipi*. Slightly enlarged. (Original.)

Plants found infested in Florida: hickory.

Other plants liable to become infested: oak; pecan.

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell’s original description in Entomological News, Vol. VIII, Number 7, 1897. The specimens were collected by Prof. P. H. Rolfs on hickory *(Carya porcina* Nutt) at Lake City, Florida.

Lepidosaphes alba (Ckll.)

“Scale of Female.—The scale of the female is about 2½ mm. long, elongate, narrow, mytiliform, convex, sometimes curved. The scales vary much, some being quite long and narrow, others broad. Color grayish-white, the exuviae, which are of the usual size, reddish-brown. Several of the scales show holes where parasites have escaped.

"The adult female is elongate, mytiliform, narrow anteriorly, with three blunt and wide lateral tubercles. Color brown."

Plants found infested in Florida: *Manihot aipi.*

Other plants liable to become infested: *Solanum.*

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in The Entomologist's Monthly Magazine, Vol. XXIX, p. 156 (1893).

Lepidosaphes nigra (Ckll.)

"Scale of the Female.—Scale 3½ mm. long (exuviae 1 1/3 mm.), pitch-black, with a narrow dull white margin; very narrow, very convex in a transverse direction, with a dorsal keel; exuviae elongated, half of the first skin on second, first skin dull orange, second skin dull dark reddish-brown."

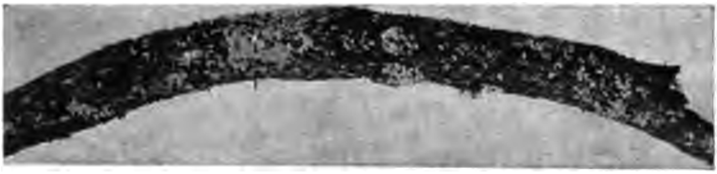

Fig. 84.—Lesser Snow Scale, *Hemichionaspis minor* (Mask.), on chinaberry (*Melia azadarach*). Natural size. (Original.)

Plants found infested in Florida: cabbage palmetto.

Other plants liable to become infested: *Agave;* laurel tree; *Yucca.*

Distribution in Florida: Ft. Pierce.

Remarks: The specimens of *Lepidosaphes nigra* (Ckll.) were collected on cabbage palmetto near Ft. Pierce, Florida, by Mr. F. F. Bibby. The above description is taken from T. D. A. Cockerell's original description in Biol. Cent. Amer. Vol. II, Part 2, p. 32, (Dec. 1899).

LESSER SNOW SCALE

Hemichionaspis minor (Mask.)

Scale of Female.—The scale of the female is from 1.8 mm. to 2.5 mm. in length. It is elongated and broadened posteriorly. It is rather thick in texture and white in color. The exuviae are yellowish-brown.

Scale of Male.—The scale of the male is similar to that of the female, but distinctly tricarinate.

Plants found infested in Florida: *Areca;* camphor; chinaberry *(Melia azadarach);* cocoanut palm; *Cocos; Croton sylvaticus;* ebony; fig; *Grevillea robusta;* hibiscus; mango; morning glory vine; mountain rose; royal poinciana; *Schizolobium excelsum;* sweet potato; *Vitis quadrangularis.*

Other plants liable to become infested: *Capsicum;* cotton; *Cycas revoluta;* oleander; orange; pepper.

Distribution in Florida: Bradentown; Cocoanut Grove; Fort Myers; Fort Pierce; Homestead; Miami; Oneco; Palm City; Palmetto; Sarasota; Tampa; West Palm Beach.

Leucaspis bambusae Kuw.

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. in length. The sides are nearly parallel, but broadened posteriorly. The scale is for the most part straight, but is sometimes curved. The scale is convex and rather thick in texture. The color is snow-white or light gray. The exuviae is large and is light or dark brown in color.

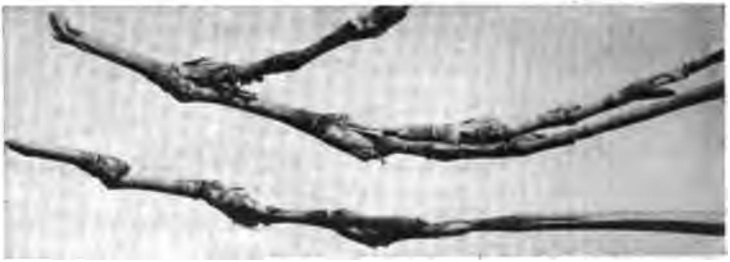

Fig. 35.—*Leucaspis bambusae* Kuw., on *Phyllostachys bambusodes.* Enlarged twice. (Original.)

Plants found infested in Florida: *Phyllostachys bambusodes.*

Other plants liable to become infested: bamboo.

Distribution in Florida: Brooksville.

Remarks: Specimens of *Leucaspis bambusae* were collected by Mr. U. C. Zeluff in the Bureau of Plant Industry Plant Introduction Station at Brooksville, Florida. Additional specimens were collected by Mr. C. M. Hunt on request.

LONG SCALE OR GLOVER'S SCALE
Lepidosaphes gloverii (Pack.)

(Fig. 36)

Scale of Female.—The scale of the female is light yellow to dark brown in color. It is elongate, broader posteriorly, and is 2 mm. (1/12 inch) in length. It is similar to *Lepidosaphes beckii*

Scale of Male.—The scale of the male is similar to that of the female, but is only about half as long.

Plants found infested in Florida: cabbage palmetto; cherry laurel; citrus; *Magnolia grandiflora.*

Other plants liable to become infested: *Magnolia fuscata;* palms.

Distribution in Florida: general.

LONG-TAILED MEALY BUG

Pseudococcus longispinus (Targ.)

Adult Female.—The length of the adult female is from 2.5 mm. to 3 mm. (1/10 inch to 3/25 inch). It is light yellow or gray in color, and is covered by a fine, white, powdery wax. The lateral filaments are slender and short. The anal filaments are four in number and are long and conspicuous, the two inner ones being the longer.

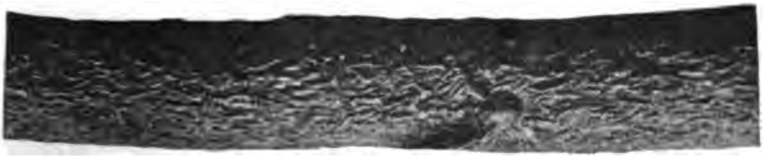

Fig. 36.—Long Scale or Glover's Scale, *Lepidosaphes gloverii* (Pack.), on orange. Enlarged twice. (Original.)

Plants found infested in Florida: *Aralia;* avocado; bamboo; citrus; mango; palm; *Plumiera;* wax vine.

Other plants liable to become infested: begonia; calla; camellia; coleus; *Croton; Cycas revoluta;* ferns; *Ficus pandurata;* fig; grape; guava; moonflower; oleander; *Opuntia;* plum; Sago palm; umbrella plant.

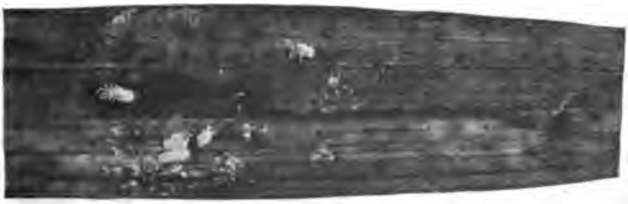

Fig. 37.—Long-tailed Mealy Bug, *Pseudococcus longispinus* (Targ.), on palm. Natural size. (Original.)

Distribution: The distribution is general over the State of Florida.

LIRIODENDRON SCALE

Toumeyella liriodendri (Gmel.)

Adult Female.—The adult female is from 4 mm. to 7 mm. (3/16 inch to 3/8 inch) in diameter. It is circular or oblong in shape and strongly convex. The surface is irregular and the color varies from grayish-green to dark brown or black.

Adult Male.—The male is a small two-winged insect, yellowish-pink in color.

Plants found infested in Florida: *Gordonia lasianthus;* Loblolly bay; *Magnolia fuscata; Magnolia grandiflora; Magnolia soulangeana.*

Other plants liable to become infested: *Liriodendron tulipifera.*

Distribution in Florida: Clearwater; Cocoa; Dade City; Federal Point; Gainesville; Groveland; Lake Hamilton; Macclenny; Oneco; Orlando; Pensacola; Tampa.

Remarks: Hymenopterous parasites, *Coccidoxenus mexicanus* Girault, were reared from specimens collected at Gainesville, Fla. Specimens from Gainesville, Groveland, Lake Hamilton, Macclenny and Orlando were infested with the larva of a coccid-eating moth, *Laetilia coccidivora. Aschersonia cubensis* was found infesting the Gainesville specimens.

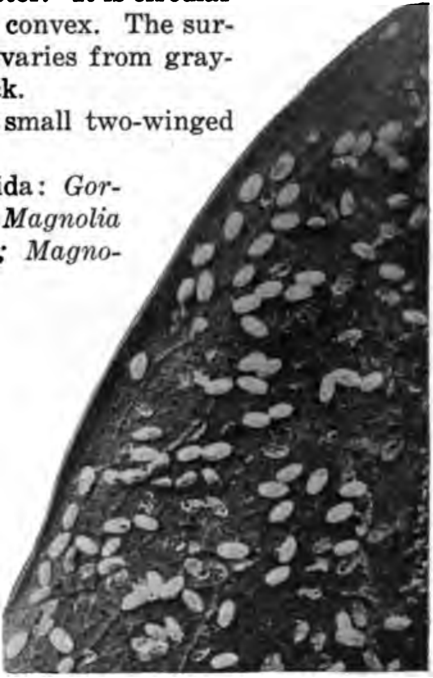

Fig. 38.—Liriodendron Scale, *Toumeyella liriodendri* (Gmel.), showing males on *Magnolia fuscata.* Enlarged twice. (Original.)

MANGO SCALE

Leucaspis indica Marlatt

Scale of Female.—The scale of the female is from .5 mm. to 1 mm. in length. It is narrow and flattened at the tip. The scale is convex and has a loosely adhering sack-like, white, waxy covering.

Plants found infested in Florida: mango.

Distribution in Florida: Buena Vista; Miami.

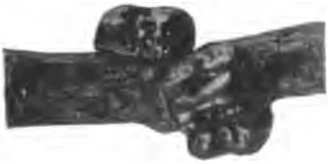

Fig. 39.—Liriodendron Scale, *Toumeyella liriodendri* (Gmel.), showing females on *Magnolia fuscata.* Enlarged twice. (Original.)

Remarks: Specimens of *Leucaspis indica* usually occur massed in cracks or under loose bark, and resemble minute seeds or eggs.

MANGO SHIELD SCALE

Coccus mangiferae (Green)

(Figs. 40 and 41)

Scale of Female.—The scale of the female is yellowish green or brown in color. In shape it is deltoid, bluntly pointed in front and broadly rounded behind. It is very thin and flat and is irregularly marked with black. The length is from 3 mm. to 4 mm. and the width from 2.5 mm. to 3.5 mm.

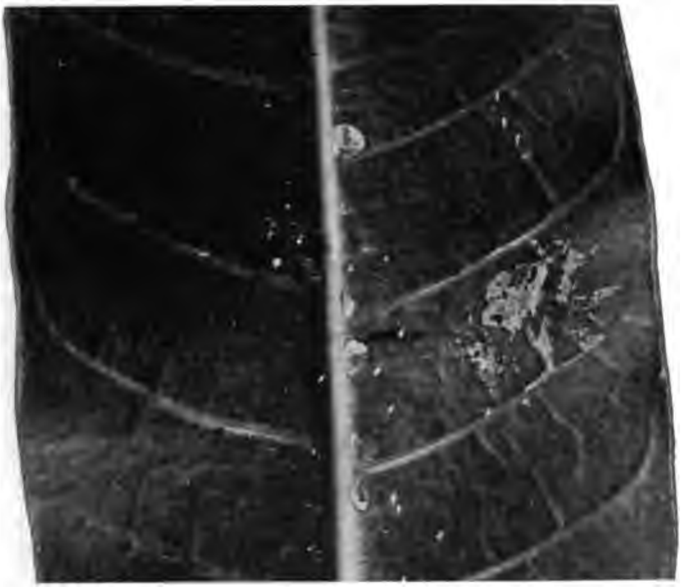

Fig. 40.—Mango Shield Scale, *Coccus mangiferae* (Green) on mango. natural size. (Original.)

Plants found infested in Florida: mango.

Other plants liable to become infested: alamanda; bread fruit; cinnamon; custard apple; Ixora; jasmine; nutmeg; Sapodilla.

Distribution: Arch Creek; Miami; Oneco; West Palm Beach.

Margarodes rileyi Giard.

Adult Female.—The adult female is found enclosed in a horny shell. In size and shape it resembles a small pea. The color is

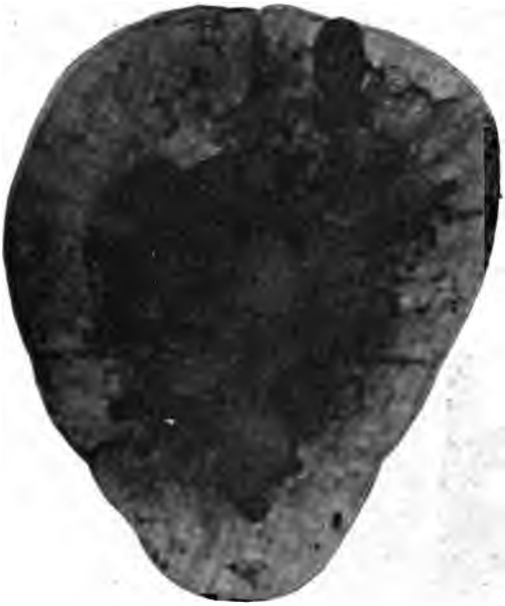

Fig. 41.—Mango Shield Scale, *Coccus mangiferae* (Green), greatly enlarged. (Original.)

light brownish yellow. This species is usually found closely associated with ants' nests.

Distribution in Florida: Florida Keys.

Remarks: Specimens of *Margarodes rileyi* Giard have not been received by the author, but have been reported as occurring on the Florida Keys.

MINING SCALE
Howardia biclavis (Comst.)

Scale of Female.—The scale of the female is almost circular in shape and is grayish or yellowish in color. The exuviae are marginal and are yellowish in color. The epidermal layer of bark from the host plant usually partly or wholly covers the scale, making it almost indistinguishable.

Male unknown.

Plants found infested in Florida: *Tabernae montana;* wisteria; white sapota *(Casimiroa edulis).*

Other plants liable to become infested: *Anona cherimolia; Anona muricata; Bixa orellono;* cinchona; coffee; *Ficus laurifolia; Flacourtia; Hybiscus aculeatus;* lime; *Microglossa zeylanica; Ochrea sapoti;* orange; tamarind; tea.

Distribution in Florida: Clearwater; Oneco; St. Petersburg.

Remarks: The specimens of this scale were collected in Clearwater, Florida, by Mr. U. C. Zeluff, on *Tabernae montana* and *wisteria.* Additional specimens were later collected by Mr. F. W. Poos, Jr., on white sapota at Oneco. Specimens of *Howardia biclavis* (Comst.) were taken at Miami, Florida, from a shipment of *Brumfelsia nitida* imported from Cuba.

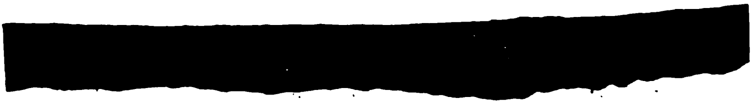

Fig. 42.—The Mining Scale, *Howardi biclavis* (Comst.), on *Tabernae montana,* natural size. (Original.)

Neolecanium cornuparvum (Thro.)

"Female Scale.—The shape is elliptical and quite convex. The dorsal cuticle is shiny brown with a tinge of gray, and it is densely alveolate, with large glands. Length, 8-10 mm.; width, 5-8 mm. The spiracular grooves leave white dust when the insect is removed from the bark. The antenna is short and stout with six indistinct segments, and is of the vestigial type. The anal plate is two hundred and forty-eight microns long (the anal plate of *hesperidum* is two hundred microns long) and is two-thirds as broad as long, with the cephalo-lateral margin longer than the caudo-lateral, and both the lateral extremity and the apex rounded. There are five subapical and four apical setae. There are two large fringe setae, one on each ventral thickening and at least sixteen hypopigial setae. There are three short, stout spiracular setae subequal in length and about one-half as broad as long, with the medium setae notched at the apex. The marginal setae are short and conical. The legs are short and stubby with a small claw. It is viviparous, with the young scales, black. The dried young have a medium carina and many transverse carinae."

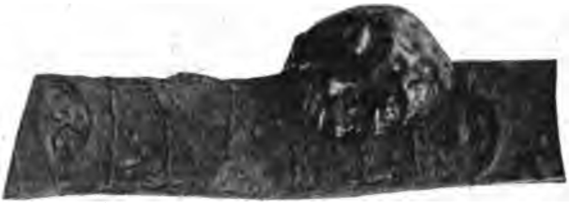
Fig. 43.—*Neolecanium cornuparvum* (Thro.), on *Magnolia grandiflora*. Enlarged twice. (Original.)

Plants found infested in Florida: *Magnolia grandiflora.*

Other plants liable to become infested: various species of magnolias.

Remarks: The writer is indebted to Prof. J. R. Watson of the Florida Experiment Station for this species. The above description is the original description of Thro.

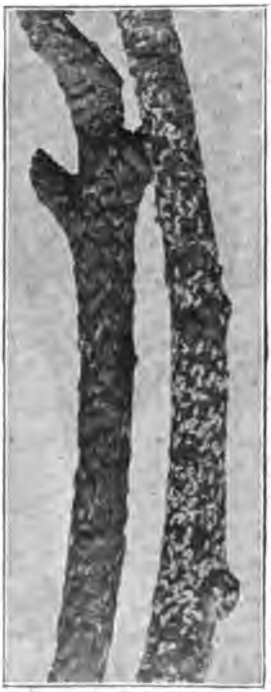
Fig. 44.—Oak Scale, *Chionaspis quercus* Comst. Enlarged twice. (After Essig, Injurious and Beneficial Insects of Cal.)

OAK CHIONASPIS
Chionaspis quercus Comst.

Scale of Female.—The scale of the fe-

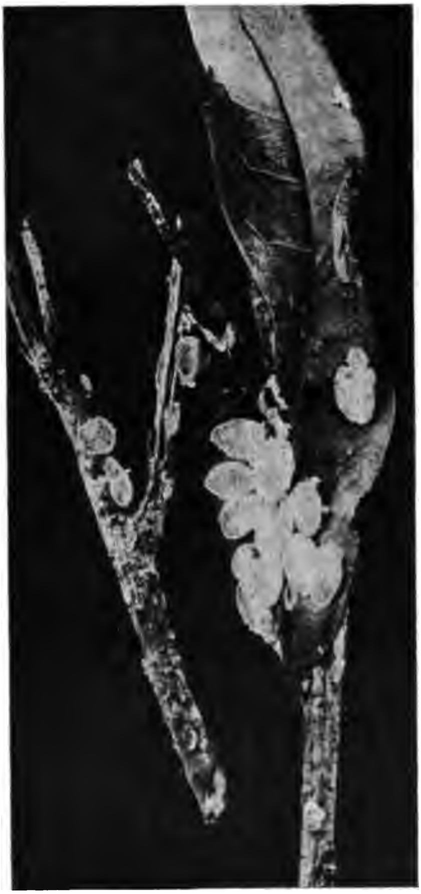

Fig. 45.—Oak Ericoccus, *Ericoccus quercus* (Comst.), on oak. Enlarged twice. (Original.)

male is 2 mm. (2/25 inch) in length. It is long and narrowed at the anterior end. The posterior end is widened. The shape is convex, and the color is light to dark gray. The exuviae are brownish yellow. The scale is usually more or less covered by dirt or hairs of the stem to which it is attached.

Scale of Male.—The scale of the male is 1.25 mm. (1/20 inch) in length and is snowy white. The exuviae are light yellow.

Plants found infested in Florida: live oak; water oak.

Other plants liable to become infested: maul oak; white oak.

Distribution in Florida: Ft. Pierce; West Palm Beach.

Remarks: The specimens of *Chionaspis quercus* were collected by Mr. F. F. Bibby on live oak and water oak from Ft. Pierce and West Palm Beach.

OAK ERICOCCUS

Ericoccus quercus (Comst.)

Female.—The body of the female is dark wine-colored and is enclosed in an oval, white, felt-like sac. It is 2.5 mm. (about ⅛ inch) in length.

Male.—The male is similar to the female, but smaller.

Plants found infested in Florida: gallberry; oak.

Fig. 46.—The Obscure Scale, *Chrysomphalus obscurus* (Comst.), on oak. Enlarged twice. (Original.)

Other plants liable to become infested: grass; *Vaccinium corymbosum.*

Distribution: Groveland; Jacksonville.

THE OBSCURE SCALE

Chrysomphalus obscurus (Comst.)

(Fig. 46)

Scale of Female.—The scale of the female is about 3 mm. in diameter. It is dark gray in color, resembling the color of the bark to which it is attached. It is slightly convex and almost circular. The exuviae are subcentral, forming a nipple-like projection, surrounded by a white ring.

Scale of Male.—The scale of the male is similar in color to that of the female, but is oval in shape.

Plants found infested in Florida: chestnut; live oak; water oak; wild myrtle.

Other plants liable to become infested: dogwood; grapevine; hickory; maple; pecan; willow oak.

Distribution in Florida: Bradentown; Ft. Pierce; Kissimmee; Macclenny; Palmetto; Sarasota; Sebring; Tampa.

Remarks: Some parasites were reared from specimens collected at Tampa, Florida.

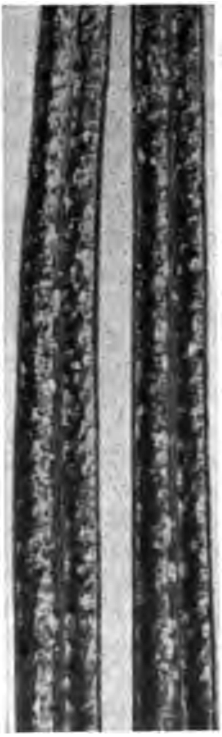

Fig. 47.—Oleander Scale, *Aspidiotus hederae* (Ball), on Sago palm. Enlarged twice. (Original.)

OLEANDER SCALE

Aspidiotus hederae (Ball)

Scale of Female.—The scale of the female is almost circular, but when found on palms one side is usually flattened by coming in contact with a vein. It is from 1.5 mm. to 2 mm. in diameter. The scale is rather flat and is dull yellow to pearly white in color. The exuviae are central or subcentral and are light yellow to orange in color. They are covered in newly moulted specimens, but in older ones are bare.

Scale of Male.—The scale of the male is similar to that of the female, but is variable in form. It is usually elongated and white.

Plants found infested in Florida: *Areca;* Australian silk oak; avocado; camphor; chinaberry; *Coccolobis;* cocoanut palm;

Cocos plumosa; English ivy; fan palm; jasmine; *Jatropha multifida;* mango; *Olea fragrans;* oleander; *Phoenix canariensis;* Sago palm; white bay *(Persea* sp.*)*.

Other plants liable to become infested: *Acacia; Agave palmeri; Alec umbellata; Amelia; Aroutus; Asparagus plumosus; Camellia; Carpodetus serratus; Cerceris;* clover; *Croton;* currant; *Cycas revoluta; Daphne gnidium;* English ivy; *Erica; Genista; Gertonia;* grass; holly; lemon; magnolia; maple; *Myrsine retusa;* olive; orange; orchids; palms; *Quercus ilex; Rubia peregrina; Ruscus aculeatus* sweet olive; *Vitex littoralis; Vriescia splendens;* Yucca.

Distribution in Florida: Astatula; Clearwater; Dundee; Federal Point; Gainesville; Jacksonville; La Grange; Lake Garfield; Miami; Oneco; Palm Beach; Port Tampa; Quincy; Rockledge; St. Petersburg; Tampa; West Palm Beach; Winter Haven.

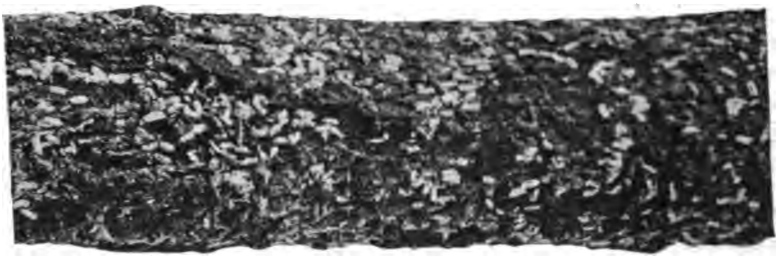

Fig. 48.—Orange Chionaspis or Snow Scale, *Chionaspis citri* Comst., on orange. Enlarged twice. (Original.)

ORANGE CHIONASPIS OR SNOW SCALE

(*Chionaspis citri* Comst.)

Scale of Female.—The scale of the female is a dirty, blackish-brown color with a gray margin. The exuviae are a brownish yellow. The scale possesses a prominent central ridge from which the sides of the scale slope to the edge.

Scale of Male.—The scale of the male is small, long, narrow and white. The exuviae are yellowish.

Plants found infested in Florida: citrus.

Other plants liable to become infested: *Euonymus latifolius; Osmanthus;* palms.

Distribution in Florida: City Point; St. Cloud; Seffner; Tampa.

OYSTER-SHELL SCALE

Lepidosaphes ulmi (Linn.)

Scale of Female.—The scale of the female is 2/25 inch (2 mm.) in length. It is dark colored, long and slender, often curved, widened posteriorly and resembles an oyster shell in shape. The exuviae are yellowish or yellowish-brown.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and has the posterior part loosened for the exit of the male.

Plants found infested in Florida: peach.

Other plants liable to become infested: *Aesculus glabra;* apple; *Arlanthus glandulosus;* ash; birch; bladder-nut; butter-nut; *Ceanothus americanus; Cornus;* currant; Cysticus; elm; hawthorn; hop tree; linden; maple; oak; pear; plum; poplar; raspberry rose; *Sassafras officinale; Stillingia sebifera; Syringa persica;* water locust; wild cherry; willow; *Yucca.*

Distribution in Florida: Macclenny.

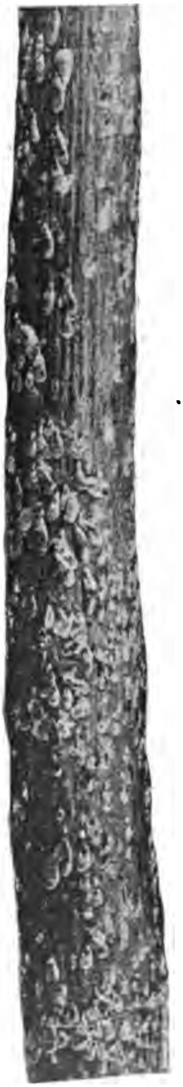

Fig. 49.—Oyster-shell Scale, *Lepidosaphes ulmi* (Linn.), on ash. Enlarged twice. Collected by Dr. E. W. Berger, Berea, O. (Original.)

PALMETTO SCALE

Comstockiella sabalis (Comst.)

(Fig. 50)

Scale of Female.—The scale of the female is from 1 mm. to 1.5 mm. in diameter. It is snowy white and irregular in outline, but approximately circular. The exuviae vary in position from central to marginal.

Scale of Male.—The scale of the male is similar to that of the female, but smaller and more elongated.

Plants found infested in Florida: cabbage palmetto; *Cocos;* cultivated spineless cactus; palmetto; *Sabal adamsonis; Sabal palmetto; Washingtonia robusta.*

Other plants liable to become infested: *Erytheaedulis.*

Distribution in Florida: Citra; Clearwater; Ft. George; Ft. Myers; Ft. Pierce; Oneco; Orlando; Palmetto; Redland; St. Petersburg;

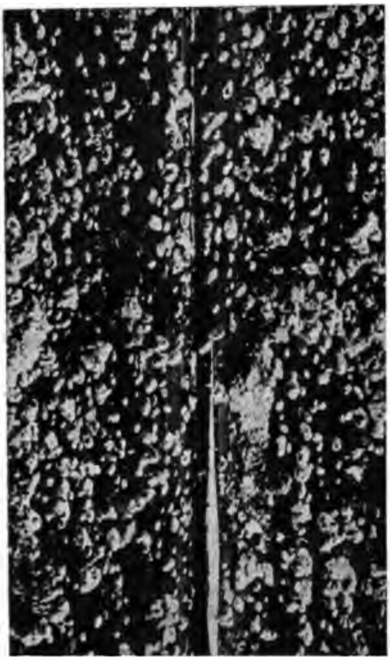

Fig. 50.—Palmetto Scale, *Comstockiella sabalis* (Comst.), on palmetto. Enlarged twice. (Original.)

Sanford; Sarasota; Tampa; Terra Ceia; West Palm Beach.

PALM OR TESSELLATED SCALE

Eucalymnatus tessellatus (Sign.)

Scale of Female.—The scale of the female is oval in shape, but broadly rounder posteriorly. It is of a dark brown color, with a decidedly mosaic appearance on the upper surface.

Scale of Male.—The scale of the male is not known.

Plants found infested in Florida: cocoanut palm; fish-tail palm; holly; palm; *Tabernae montana.*

Other plants liable to become infested: cinnamon; coffee; fern; laurel; *Laurus noblis; Lignum vitae;* orchid; rattan palm; *Sapidus saponaria.*

Distribution in Florida: Clearwater, Gainesville; Jacksonville; Little River; Oneco; Palm Beach; St. Petersburg; West Palm Beach.

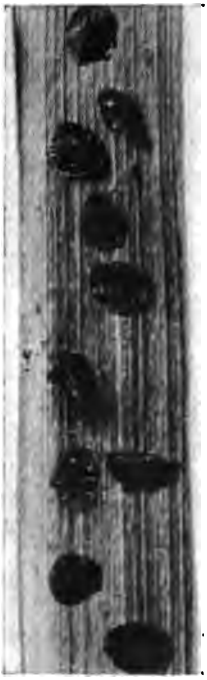

Fig. 51.—Palm or Tessellated Scale, *Eucalymnatus tessellatus* (Sign.), on cocoanut palm. Enlarged twice. (Original.)

THE PARLATORIA-LIKE SCALE

Pseudoparlatoria parlatorioides (Comst.)

(Fig. 52)

Scale of Female.—The scale of the female is 1.4 mm. (1/20 inch) in diameter. It is circular in shape with the exuviae marginal. The exuviae are large, extending from the margin to the center of the scale. The color of the scale is light yellow and the exuviae are a similar color or brownish.

Plants found infested in Florida: cabbage palmetto; camphor; cocoanut palms; mastic; *Persea carolinensis; Seaforthia; Washingtonia robusta.*

Other plants liable to become infested: *Drimys; Magnolia grandiflora; Oncidium varicosum;* peach; *Psidium.*

Distribution in Florida: Boynton; Ft. Myers; Manatee; Miami; Oneco; Palm Beach; Sebring; West Palm Beach.

PINEAPPLE MEALY BUG

Pseudococcus bromeliae (Bouché)

Adult Female.—The adult female is from 2 mm. to 2.5 mm. in length. The color is pink. The body is sparsely covered with wax. The lateral filaments and legs are short. The body segments are distinct.

Plants found infested in Florida: pineapple.

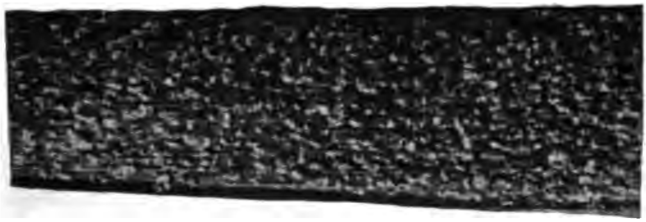

Fig. 52.—The Parlatoria-like Scale, *Pseudoparlatoria parlatorioides* (Comst.), on cabbage palmetto. Enlarged twice. (Original.)

Other plants liable to become infested: canna; hibiscus; mulberry.

Distribution in Florida: Delray.

Remarks: This species was collected by Mr. F. F. Bibby at Delray, Florida, on pineapples shipped from Cuba.

PINEAPPLE SCALE

Diaspis bromeliae (Kern.)

(Fig. 53)

Scale of Female.—The diameter of the scale is from 2 mm. to 2.5 mm. (7/100 inch to 9/100 inch) in length. It is circular and thin, and is white or light gray in color. The exuviae are light yellow.

Scale of Male.—The scale of the male is strongly carinate and white in color. The exuviae are yellow.

Plants found infested in Florida: pineapple.

Other plants liable to become infested: *Billbergia zebrina; Bromelia pinquin;* canna; hibiscus; ivy; *Olea fragrans.*

Distribution: Clearwater; Ft. Pierce; Oneco.

THE PINE-LEAF SCALE INSECT

Chionaspis pinifolia (Fitch)

(Fig. 54)

Scale of Female.—The scale of the female is about 3 mm. (1/10 inch) in length. It is snowy white in color, usually long and narrow, but sometimes broad. The shape seems to depend upon the shape of the leaf to which it is attached. The exuviae are light yellow.

Scale of Male.—The scale of the male is slightly broadened posteriorly, and is about half the size of the female. The exuviae are pale yellow or colorless.

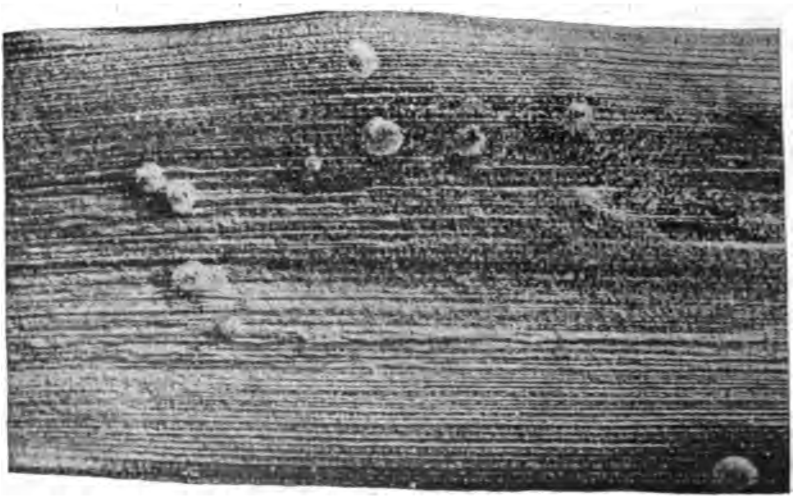

Fig. 53.—Pineapple Scale, *Diaspis bromeliae* (Kern.), on pineapple. Enlarged twice. (Original.)

Plants found infested in Florida: juniper; pine.

Other plants liable to become infested: pine; spruce; other coniferous trees.

Distribution in Florida: Bradentown; Fort George; Gainesville; Palmetto; Sarasota.

PINE SCALE

Chionaspis pinifoliae heterophyllae Cooley

This species is indistinguishable from *Chionaspis pinifoliae* except by the lobes of the pygidium. The scale is usually found near the base of the long leaves or on the bark of succulent twigs.

Plants found infested in Florida: Cuban pine *(Pinus heterophylla)*; *Pinus mitis.*

Other plants liable to become infested: pines.

Distribution in Florida: Ft. George; Gainesville; Palmetto; Winter Haven.

Pseudococcus calceolariae (Mask.)

"Adult Female.—The adult female is pink in color, and covered with a white meal. The body is pretty regularly oval, the segments very distinct; the appendages are short except at the posterior end where there are two very long, with, on each side of them, another somewhat shorter. The two longest surround the hairs of the anal tubercles; which are inconspicuous, and between them is visible the white pencil of meal surrounding the anal setae."

Plants found infested in Florida: sugar cane.

Other plants liable to become infested: *Calceolaria; Cordyline australis; Danthonia; Phormium tenax.*

Remarks: This species is reported as occurring in Florida, but has not been received by the author. The above description is taken from Maskell's original description, Transactions of the New Zealand Institute, XI, pp. 218-219 (1878).

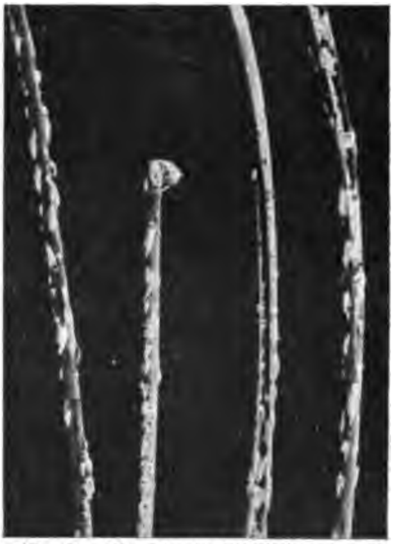

Fig. 54.—The Pine-leaf Scale-insect, *Chionaspis pinifolia* (Fitch), on pine. Enlarged twice. (Original.)

Pseudococcus quaintancii (Tinsley)

"Adult Female.—Lengh 2 mm., width 1.5 mm., shape ellipsoidal, much flattened, color dark grayish-brown. The body is so covered with white secretion that its true color only shows on the ventral surface, the color of the dorsum appearing quite white. The white secretion mealy, projecting slightly on the lateral margins, but not forming well developed filaments; posteriorly it is produced into two very short, but well defined, caudal filaments; on the dorsum it is slightly raised into a longitudinal ridge. In addition to the mealy secretion, there is some fine, waxy, thread-like secretion. They produce no well-defined ovisac, only a fluffy mass of secretion."

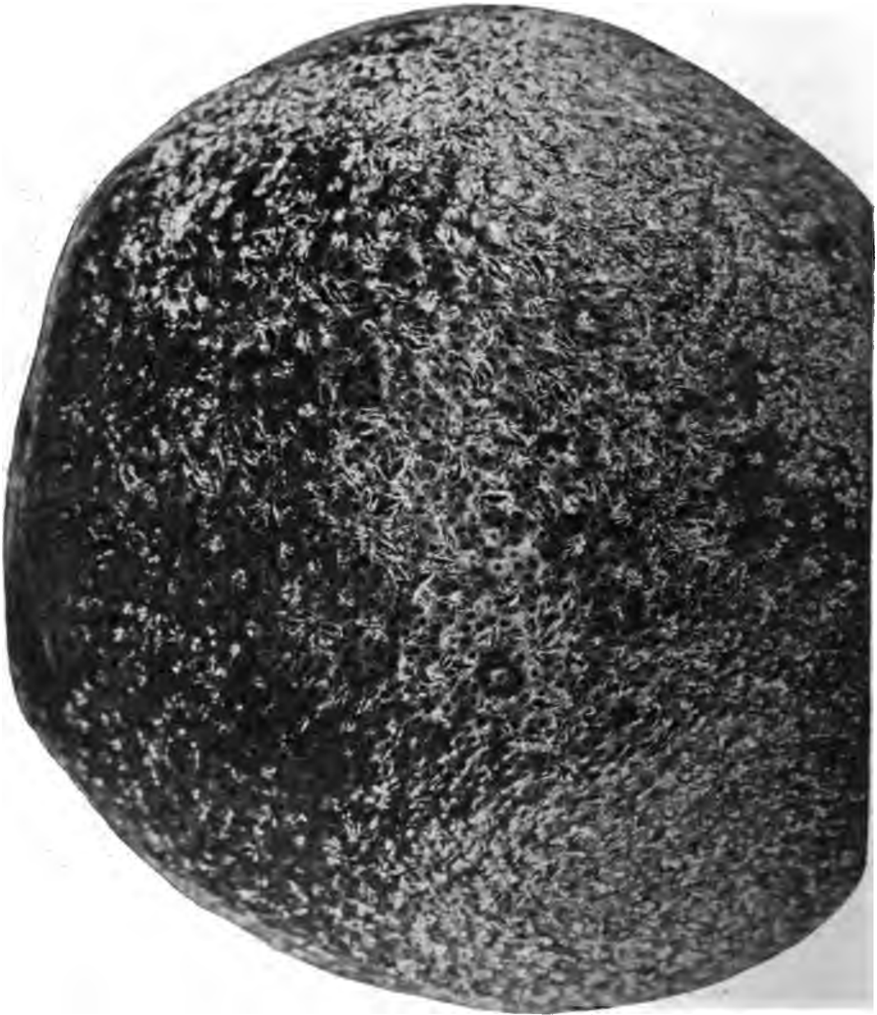

Fig. 55.—Purple Scale, *Lepidosaphes beckii* (Newm.), on orange. Enlarged twice. (Original.)

Remarks: The above description is from the Canadian Entomologist, Vol. XXX, page 220, 1898, from J. D. Tinsley's original description of specimens sent him by A. L. Quaintance from Lake City, Florida, on *Rhus copallina* L.

This species has not been received by the author.

PURPLE SCALE

Lepidosaphes beckii (Newm.)

(Fig. 55)

Scale of Female.—The scale of the female is from 2.5 mm. to 3 mm. (about 1/10 inch to 1/7 inch) in length. It is elongate and oyster shell shaped. The scale is slender and nearly straight (often curved when crowded). It is broader in the posterior portion.

Scale of Male.—The scale of the male is very similar to that of the female, but smaller.

Plants found infested in Florida: Chinese holly; citrus; Italian lemon; mango; oak; orange jessamine; pecan.

Other plants liable to become infested: *Banksia integrifolia; Cercidiphyllum japonicum; Croton; Elaeagnus;* fig; *Pomaderris apetala; Taxus cuspidata.*

Distribution in Florida: general.

PUSTULE SCALE

Asterolecanium pustulans Ckll.

Scale of Female.—The scale of the female is from 1 mm. to 1.5 mm. in diameter. It is irregular in shape, usually oblong, but often circular. It is convex above and semitransparent. Fresh specimens are of a light yellowish green color or yellow with a pale pink fringe of hair-like projections around the edge. Dried specimens are a straw color. On oleander this scale lies in the sunken part of the pustule. The formation of pustules is not so noticeable on the other host plants as on oleander and fig.

Plants found infested in Florida: Australian silk oak; custard apple; fig; *Grevillae robusta;* hibiscus; mango; mulberry; oleander; peach; persimmon.

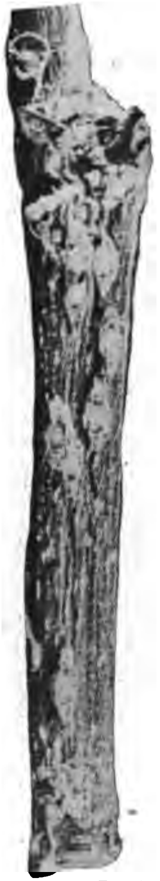

Fig. 56.—Pustule Scale, *Asterolecanium pustulans* Ckll., on oleander. Enlarged twice. (Original.)

Other plants liable to become infested: *Anona reticulata;* pigeon peas.

Distribution in Florida: Bradentown; Clearwater; Cocoanut Grove; Fort Pierce; Homestead; Lake Worth; Little River; Miami; Palmo Sola; Palmetto; Passagrille; Saint Petersburg; Seffner; Tampa; West Palm Beach; Winter Haven.

PUTNAM'S SCALE
Aspidiotus ancylus (Putnam)

Scale of Female.—The scale of the female is approximately circular, although when found growing close together in groups, it is slightly longer than wide. The diameter is from 1 mm. to 1.5 mm. The exuviae are brick-red and are covered by a grayish or whitish excretion, which is easily removed. The remaining part of the scale is dark gray or almost black and has a slightly reddish tinge. The body of the female is yellow or orange yellow.

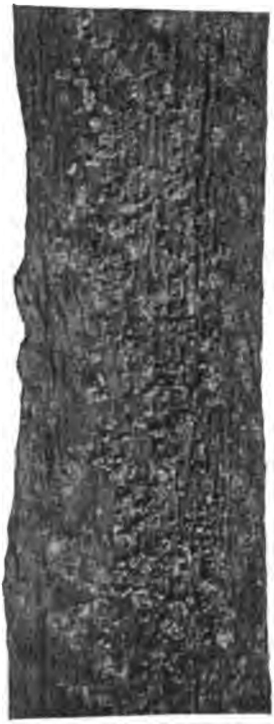
Fig. 57.—Putnam's Scale, *Aspidiotus ancylus* (Putnam), on peach. Natural size. (Original.)

Scale of Male.—The scale of the male is similar in color to the scale of the female, but slightly smaller and more elongated.

Plants found infested in Florida: chestnut; peach; pecan.

Other plants likely to become infested: apple; ash; beech; bladdernut; cherry; currant; elm; hackberry; hawthorne; linden; locust; maple; oak; osage orange; pear; plum; quince; snowball; tulip; willow.

Distribution in Florida: Bellair; Macclenny.

PYRIFORM SCALE
Pulvinaria pyriformis Ckll.
(Fig. 58)

Adult Female.—The adult female is rounded or ovate, convex above and transversely corrugated. It is light to dark brown in color. The egg-sac is composed of white, cottony material, which eventually pushes out on all sides, leaving the scale resting on the cottony mass. The length is from 2 mm. to 4 mm. (1/12 inch to 1/6 inch).

Plants found infested in Florida: *Acalypha;* avocado; Cape jasmine; Chinese cinnamon; cinnamon; English ivy; grapefruit; guava; mango; *Rhyncospermum;* rose apple; *Sapodilla;* Star jasmine; *Warneria thunbergia.*

Other plants liable to become infested: *Caprifolia; Cordea.*

Distribution in Florida: Bradentown; Bridgeport; Clearwa-

ter; Cocoa; Daytona; Elfers; Ft. Myers; Frostproof; Lakeland; Largo; Miami; Oneco; Orlando; Ormond; Ozona; Palm Beach; Pensacola; Rita; St. Cloud; St. Petersburg; San Antonio; Tampa; Tarpon Springs; West Palm Beach; Winter Haven; Winter Park.

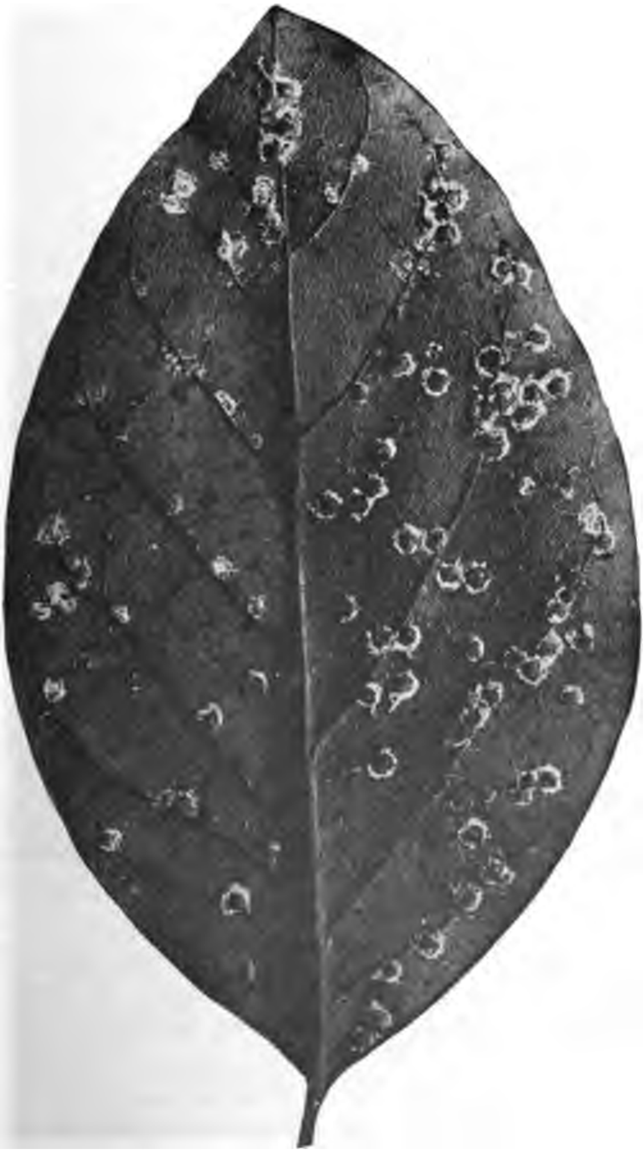

Fig. 58.—Pyriform Scale, *Pulvinaria pyriformis* Ckll., on avocado. Slightly enlarged. (Original.)

RED BAY SCALE

Chrysomphalus perseae (Comst.)

Scale of Female.—The scale of the female is from 3/50 inch to 2/25 inch (1.5 mm. to 2 mm.) in diameter. It is flat and circular, and of a reddish brown color or almost black. The exuviae are nearly central in position and are dark gray or black in color.

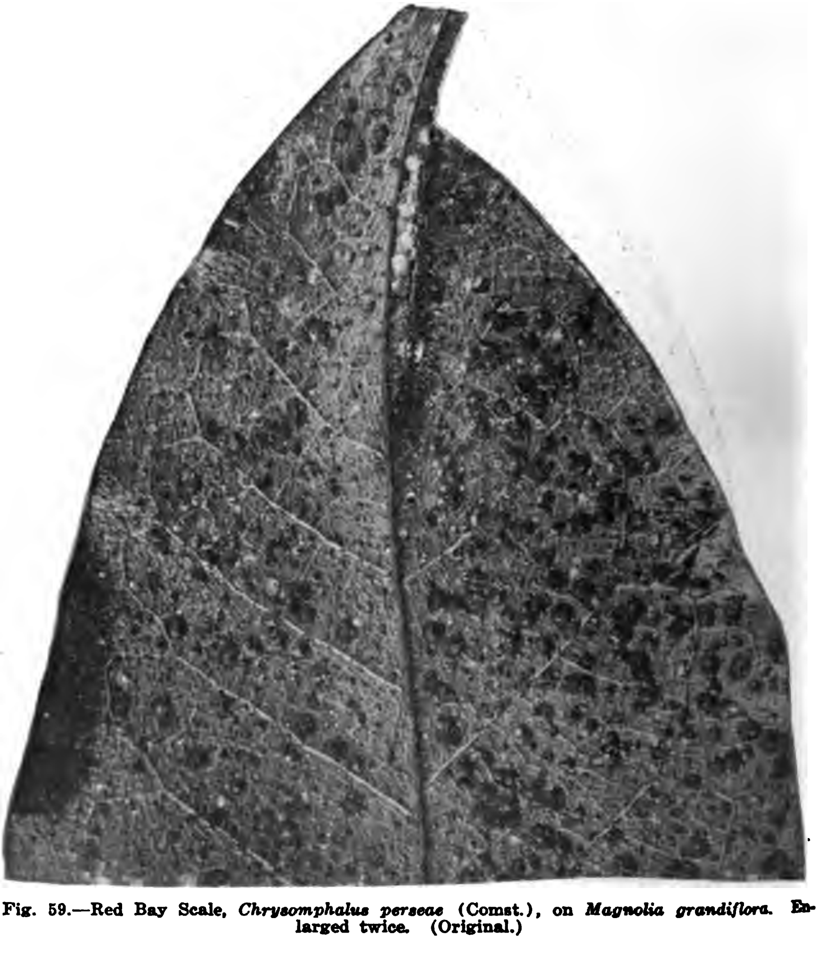

Fig. 59.—Red Bay Scale, *Chrysomphalus perseae* (Comst.), on *Magnolia grandiflora*. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is similar to that of the female, but is smaller and more elongate, with the black exuviae near the anterior end.

Plants found infested in Florida: cabbage palmetto; hammock bay; *Magnolia grandiflora;* olive; orchids; red bay *(Persea carolinensis);* short leaf pine.

Other plants liable to become infested: *Anthurium;* cocoanut palm; *Harrisii; Ilex; Magnolia glauca;* pine; *Viburnum.*

Distribution in Florida: Cedar Keys; Ft. Pierce; Gainesville; Lake City; Orlando; West Palm Beach.

ROSE SCALE

Aulacaspis rosae (Bouche)

Scale of Female.—The scale of the female is from 2 mm. to 3 mm. in diameter. It is circular or oval in single specimens, but when clustered is irregular in shape. It is thin and white or grayish white in color. The exuviae are marginal or submarginal and light yellow to dull brown in color.

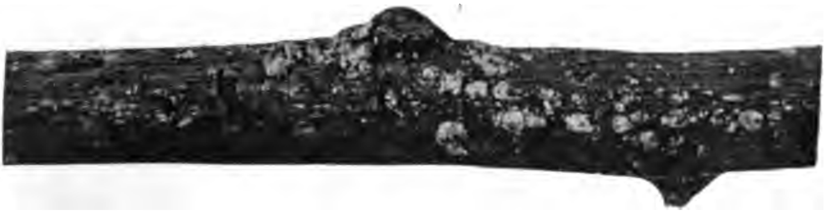

Fig. 60.—Rose Scale, *Aulacaspis rosae* (Bouche), on rose. Natural size. (Original.)

Scale of Male.—The scale of the male is elongated, narrow, white in color and tricarinate. The exuviae are terminal.

Plants found infested in Florida: rose.

Other plants liable to become infested: *Ailanthus;* blackberry; *Cycas;* mango; myrtle; pear; strawberry.

Distribution in Florida: Pensacola; Sanford.

THE ROSE PALAEOCOCCUS

Palaeococcus rosae (Riley & Howard)

(Fig. 61)

"Adult Female.—Similar in size to adults of *Icerya purchasi,* broadly oval in shape and densely covered with a short powdery secretion which forms a series of short close plaits around the margin. The waxy secretion has often a yellowish tinge. No distinctive egg-sac was to be found with any of the specimens received, and it is probable that such is not formed. Removing the secretion, the head and thorax are black, margined with red, while the dorsum of the abdomen and entire under side of the body are bright red; antennae, legs, and eyes black. Surface of the body covered with short hairs, lateral margin with longer hairs, still longer near anal end. Divisions of segments plainly marked, especially of abdomen, which has a broad rounded subdorsal ridge. On first issuing from the third stage the adult is only moderately convex, but advanced specimens are much swollen and appear more naked. The antennae are like those of *Icerya purchasi.*"

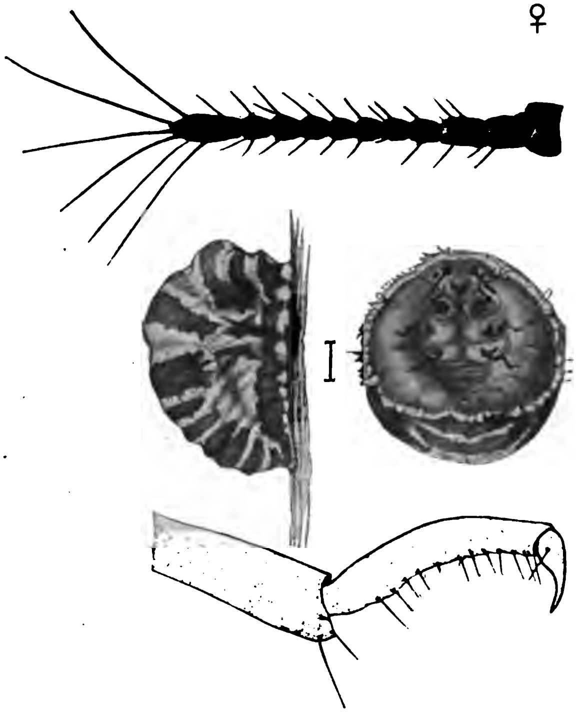

Fig. 61.—The Rose Palaecoccus, *Palaeococcus rosae* (R. & H.): Above, antenna of female; at left, pregnant female, side view; at right, same, ventral view; below, tarsus of female. (From Insect Life, Vol. III, p. 96, U. S. Dept. of Agr.)

Plants found infested in Florida: rose.

Other plants liable to become infested: *Amherstia noblis;* citrus; *Euphorbia; Hakea gibbosa; Lignum-vitae; Prosopis julifera;* sugar apple.

Distribution in Florida: Key West.

Remarks: The above description is taken from "Insect Life" Vol. III, p. 96.

RUFOUS OR WEST INDIAN RED SCALE
Selenaspidus articulatus (Morg.)

(Fig. 62)

Scale of Female.—The scale of the female is from 2 mm. to 2.5 mm. in diameter. It is semitransparent, pale brown or yellowish-brown in color, with paler margins. The scale is flat and approximately circular. The exuviae are central or subcentral and yellowish or orange color.

Plants found infested in Florida: citrus; oleander.

Other plants liable to become infested: *Cordyline terminalis;*

Dictyosperma album; Ficus; Gardenia; Ixora coccinea; palms; *Pandanus.*

Distribution in Florida: Key West.

Remarks: Specimens of this species were collected on lime in Key West, Florida, by Mr. H. M. McKay and specimens imported on shipments from Cuba were taken by Mr. A. C. Brown at Tampa, Florida.

SAN JOSE SCALE

Aspidiotus perniciosus Comst.

(Fig. 63)

Scale of Female.—The scale of the female is from 1 mm. to 2 mm. in diameter. It is circular in shape, slightly convex and of a gray color. The exuviae are central or subcentral, pale yellow to reddish yellow or dark.

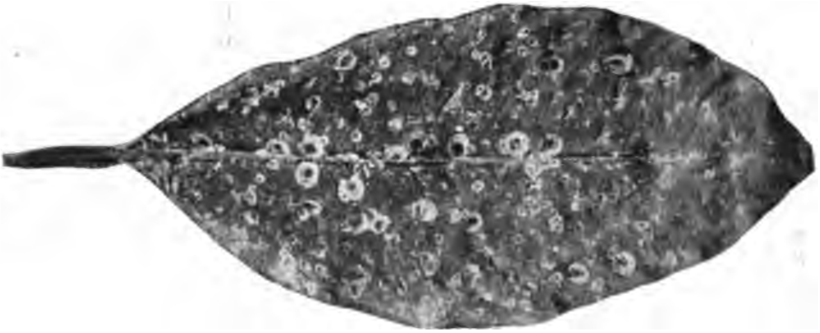

Fig. 62.—Rufous or West Indian Red Scale, *Selenaspidus articulatus* (Morg.), on lime. Enlarged twice. (Original.)

Scale of Male.—The scale of the male is oblong and dark, sometimes being black. The exuviae are subcentral. The length is usually about twice the diameter.

Plants found infested in Florida: apple; cherry; *Citrus trifoliata;* fig; flowering quince; laurel; lombardy poplar; peach; pear; pecan; plum; *Prunus carolina;* red osier; rose; *Siebaldiana;* wild crabapple.

Other plants liable to become infested: alder; apricot; ash; black walnut; Carolina poplar; catawba; cedar; chestnut; *Crataegus;* currant; dogwood; elm; English walnut; *Eucalyptus; Euonymus;* gooseberry; Japan walnut; laurel; linden; milkweed; persimmon; quince; raspberry; silver maple; *Spiraea;* spruce; strawberry; sumac; willow.

SOFT BROWN SCALE

Coccus hesperidum (Linn.)

(Fig. 64)

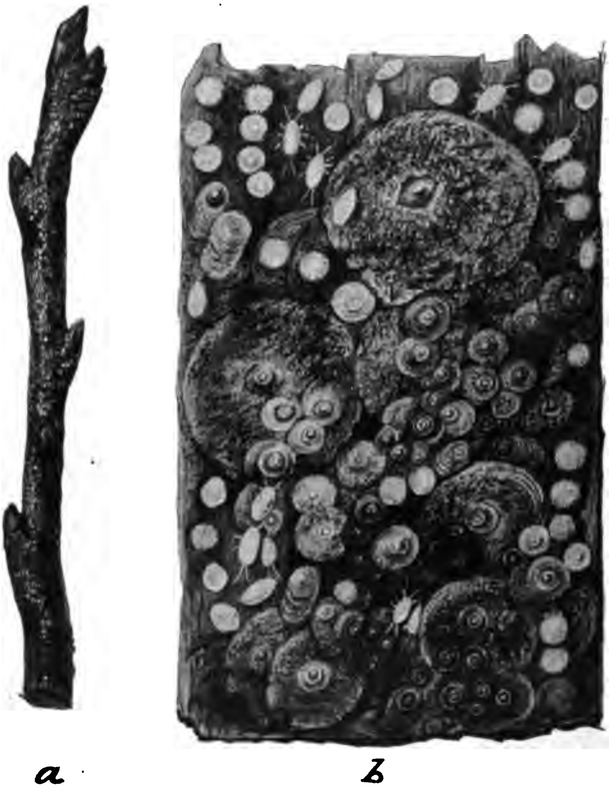

Fig. 63.—Appearance of San Jose scale, *Aspidiotus perniciosus*, on bark; *a*, infested twig, natural size; *b*, bark as it appears under hand lens. (From Bul. No. 62, U. S. D. A., Bureau of Ent., Fig. 2, p. 35.)

Scale of Female.—The scale of the female is oval and flat. It is soft and more or less swollen and is yellowish or light brown in color. The young scales are transparent.

Scale of Male. — The scale of the male is a yellow and very minute two-winged insect.

Plants found infested in Florida: apollo laurel; avocado; bay; citrus; *Croton;* ebony; English ivy; fern; fish-tail palm; guava; jasmine; loquat; oleander; persimmon; *Philibertella clausa;* rose; royal palm; *Tabernae montana; Talinum* sp.; *Washingtonia robusta;* wisteria.

Other plants liable to become infested: *Camellia;* clematis; *Cycas revoluta;* holly; mimosa; *Morus nigra;* myrtle; oleander.

Distribution in Florida: generally distributed.

SWEET GUM SCALE

Cryptophyllaspis liquidambaris Kotinsky

(Fig. 65)

Female Gall.—The female gall is found mostly on the upper side of the leaf and is from .5 mm. to 2 mm. high. The gall is bluntly conical in shape.

Female Scale.—The scale of the female is found mostly on the under side of the leaf. It is oval in shape, white in color and waxy in appearance. The central portion of the scale lies within the gall cavity immediately below the level of the surface of the leaf. The exuviae are large and lemon-yellow in color.

Scale of Male.—The scale of the male is similar to the scale of the female. Usually the male scales are found in groups around the glands of the leaf.

Plants found infested in Florida: red maple *(Acer rubrum)*; sweet gum.

Distribution in Florida: Bradentown; Gainesville; Lutz; Macclenny; Palmetto.

Toumeyella parvicornis (Ckll.)

"Adult Female. — Female scale about 5 mm. long, 4 broad and 3 high, of the ordinary Lecanium form, rather shiny; with irregular longitudinal series of conspicuous pits, one row on each side subdorsally, and two irregular and subconfluent rows laterally. Color of scale ochreous often with a pinkish tinge, with irregular black spots accompanying the rows of pits. Sometimes there are suffused blackish longitudinal bands in place of the spots. Under surface of female dull pink.

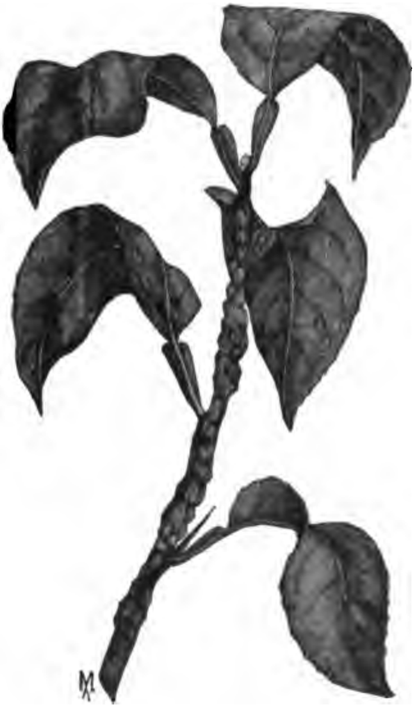

Fig. 64.—Soft Scale, *Coccus hesperidum* (Linn.), on orange. (From Farmers Bul. No. 172, p. 30, Fig. 23.)

"The female, boiled in caustic soda, turns the liquid crimson. The eggs inside her turn bright crimson, strongly contrasting with her yellowish-brown skin. Mouth-parts very small for the size of the insect. Antennae short and broad, rudimentary, about 2½ times as broad, tipped with bristles, joints obscure. Legs equally rudimentary. Skin not tessellate, but with scattered gland-spots. The skin is very little chitinised, except in the anal region. Male scales ordinary, granular, more or less overlapping.

"Newly hatched larvae oval, pale pinkish, with two very faint suffused longitudinal dorsal bands of darker color."

Plants found infested in Florida: pine.

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in Psyche, Vol. VIII, pp. 90-91 (1897).

Toumeyella turgida (Ckll.)

(Fig. 66)

"Scale of Female.—Scale of female 5½ mm. long, 4½ wide, 3¼ high. Dark reddish-brown, very shiny, swollen into irregular pustule-like prominence, with large punctiform depressions between.

"The female boiled in caustic soda, turns the liquid dark sepia, and gives a slight musky odor. Dermis chitinous, orange-brown, not reticulated, presenting numerous small glandspots. Marginal spines excessively minute. Mouth parts very small, rostral loop very short. Antennae very small, short and very stout, bristly at tip, segmentation obscure. Legs, very small and stout. Coxa considerably broader than long; femur very broad, and not much longer than broad; tibia a little longer than tarsus, and about one fourth longer than broad. Claw short and stout, much curved. Digitules comparatively short, filiform.

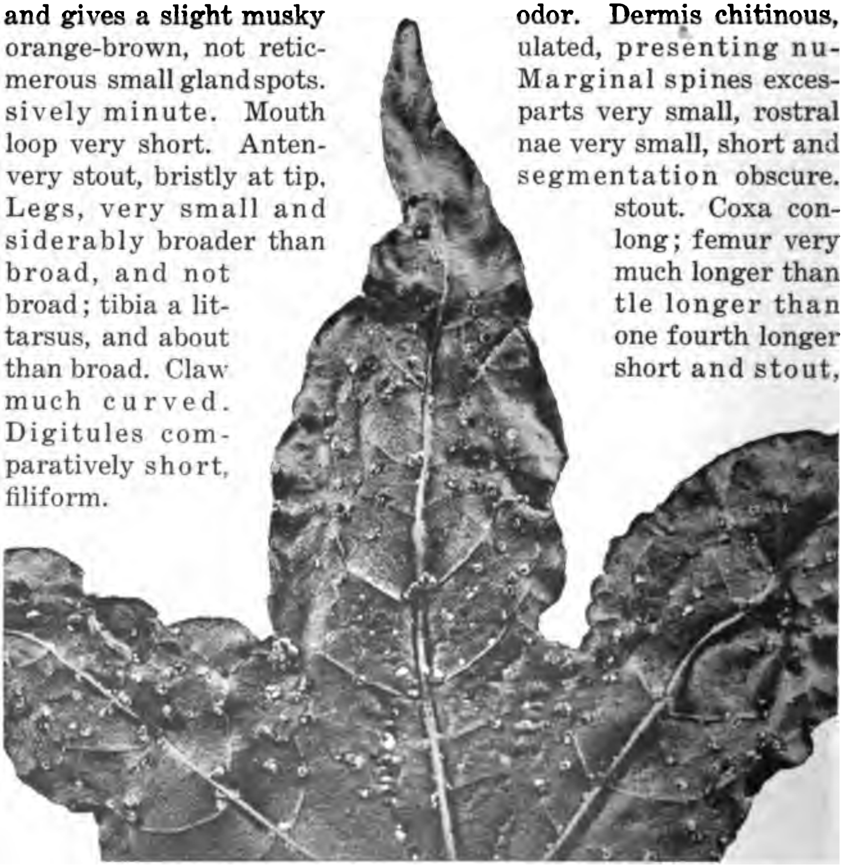

Fig. 65.—Sweet Gum Gall Scale, *Cryptophyllaspis liquidambaris* Kotinsky, on sweet gum. Enlarged twice. (Original.)

"The embryonic larvae is remarkable for the large marginal spines, about 17 on each side."

Plants found infested in Florida: *Magnolia glauca; Magnolia grandiflora.*

Distribution in Florida: Lake City.

Remarks: The above description is taken from T. D. A. Cockerell's original description in Psyche Vol. VIII, p. 152 (1897).

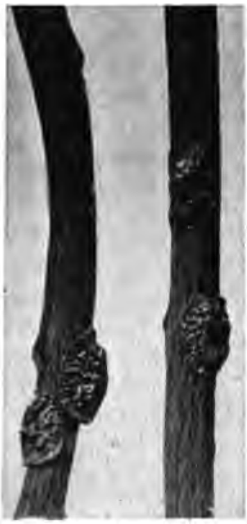

Fig. 66.—*Toumeyella turgida* (Ckll.), on *Magnolia grandiflora.* Slightly enlarged. (Original.)

West Indian or White Peach Scale

Aulacaspis pentagona (Targ.)

(Fig. 68)

Scale of Female.—The scale of the female is from 1 mm. to 2 mm. in diameter. It is usually circular, often ovate, thick and convex. The color is white or dark gray. The exuviae are bright orange-yellow or red in color and are situated between the center and the outer edge of the scale.

Scale of Male.—The scale of the male is similar in color to that of the female, but is elongated and narrow. It is usually white in color and often faintly tricarinate.

Plants found infested in Florida: chinaberry; holly; Japanese persimmon; locust; mulberry; okra *(Hibiscus esculentis);* peach; pepper; persimmon; plum; privet.

Other plants liable to become infested: *Acanthus;* apricot; *Argyreia speciosa;* bastard cedar *(Guaguma ulmifolia); Bryophillum calycinum; Callacarpa lanata; Calotropis procera; Carica papaya;* cherry; cherry laurel; cotton; *Cycas circinalis; Cycas media;* geranium; grape; heliotrope; *Jasmimum;* pear; pecan; *Pelargonium;* pepper *(Capsicum);* privet; prune; *Ricinus communis; Sedum; Tylophora asthmatica;* walnut; *Zamia mexicana; Zizyphus.*

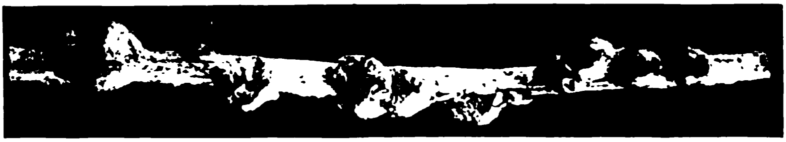

Fig. 67.—White Oak Scale, *Lecanium quercifex* **Fitch, on water oak. Enlarged twice. (Original.)**

WHITE OAK SCALE

Lecanium quercifex Fitch

(Fig. 67)

"Adult Female.—Shape elliptical, tapering slightly at both ends; dorsal cuticle dark brown, with small clear areas each of which contains a very small dot; length 4 mm.; width 3 mm.; antennae seven segmented, with the third and fourth subequal; anal plate slightly more than one half as broad as long, with the lateral margins subequal, and the lateral extremity and the apex rounded; with two subapical and four apical setae in each plate, with the latter clustered at the apex and the anterior seta one-ninth of the length of the plate from the apex; with four fringe setae, subequal in length, in groups of two; with short transverse rows of short striations on the hypopigium; all of the spiracular setae long and conical, with the first of each group slightly over one-half as long as the middle one; most of the marginal setae short and blunt, with the longest less than one half as long as the first spiracular setae; oviparous."

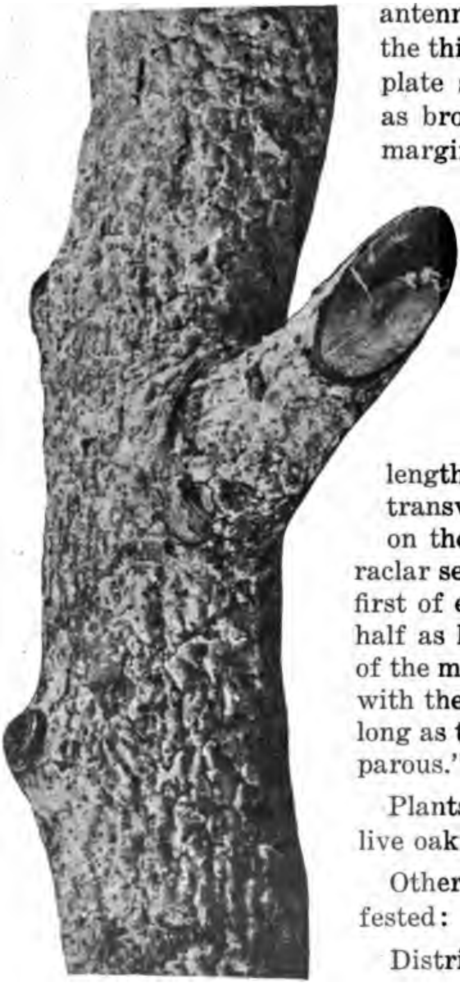

Fig. 68.—West Indian or White Peach Scale, *Aulacaspis pentagona* (Targ.), on persimmon. Enlarged twice. (Original.)

Plants found infested in Florida: live oak; water oak *(Quercus nigra)*.

Other plants liable to become infested: white oak; willow oak.

Distribution in Florida: Gainesville; Marianna; Tampa.

Remarks: The above description is taken from Thro, Bulletin 209, Cornell University Exp. Sta., p. 213 (1903).

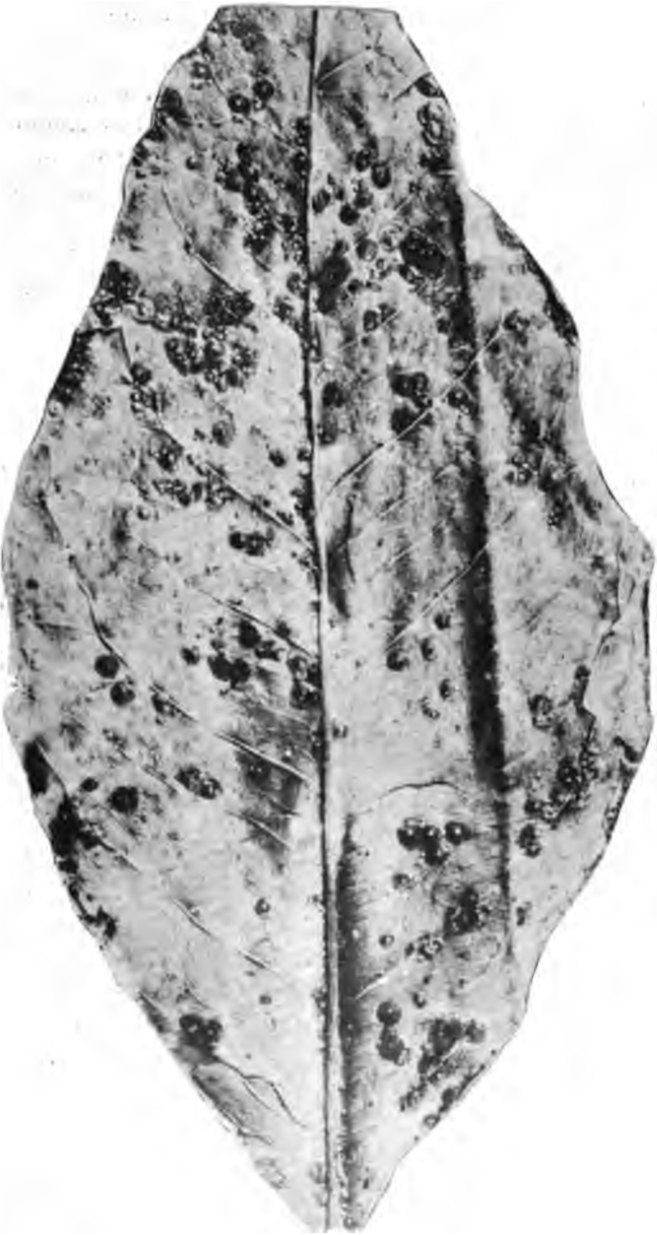

Fig. 69.—Yellow Scale, *Chrysomphalus citrinus* (Coquillett), on orange. Enlarged twice. From specimens collected by E. O. Essig, Chico, Cal. (Original.)

Yellow Scale

Chrysomphalus citrinus (Coquillett)

(Fig. 69)

Scale of Female.—The scale of the female is circular with rough and irregular edges. It is very flat and yellow in color. The diameter is from 1/16 inch to 1/8 inch. This species is distinguished from the red scale of California *(Chrysomphalus aurantii* (Mask.)*)* by its color and feeding habits.

Plants found infested in Florida: citrus.

Other plants liable to become infested: *Aucuba;* Daphne; English ivy; Euonymus; *Ficus indica.*

Distribution in Florida: Cocoa.

Ziziphus Scale

Parlatoria ziziphus (Lucas)

Scale of Female.—The scale of the female is from 1.25 mm. to 2 mm. (1/25 inch to 1/12 inch) in length. It is black with a grayish or whitish posterior portion, and is circular or elongated in shape.

Scale of Male.—The scale of the male is white, brownish or yellow in color. It is elongate and about half the length of the female. The exuviae are black.

Plants found infested in Florida, none.

Plants liable to become infested: date palm; orange; *Ziziphus pinnachristi.*

Remarks: The specimens examined by the author were found on Italian lemon taken in market and on oranges from Spain, taken by Mr. E. L. Gehry at Key West, Fla.

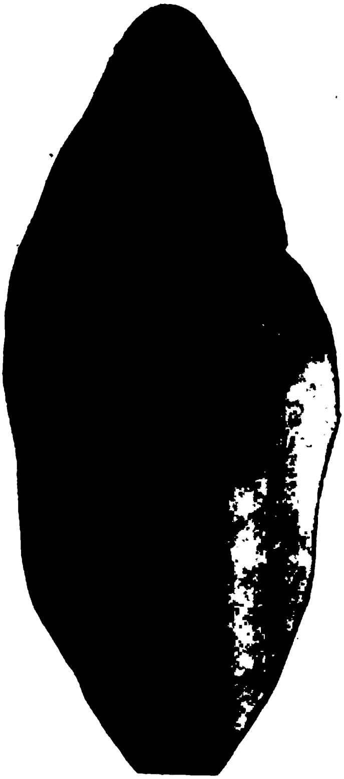

Fig. 70.—Ziziphus Scale, *Parlatoria ziziphus* (Lucas), on orange. Enlarged twice. Specimens collected by Prof. H. H. Hume, in Spain. (Original.)

Unidentified Species

In gathering the material for this bulletin, two undescribed species have been received, (1) *Kermes* spp., collected by Mr. F. F. Bibby, Ft. Pierce, Fla., on water oak, and

(2) *Orthesia* sp., collected by Mr. Geo. D. Sloan, Elfers, Fla., on Spanish moss. These species were sent to Mr. E. R. Sasscer, Chief Inspector of the Federal Horticultural Board, for identification, and reports on them have not been received in time to include in this bulletin.

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CONTROL OF SCALE-INSECTS, OR COCCIDAE, IN FLORIDA*

E. W. Berger

For the purpose of control, insects injurious to plants may be divided into those that bite and chew their food (grasshoppers, beetles, caterpillars and others) and those that suck the liquids of plants by penetrating the surface by means of their sucking beaks (scale-insects, plant-bugs, plant-lice or aphids, and others). As just indicated, scale-insects belong to the group of sucking insects.

Scale-insects, on the other hand, are divided into two principal groups, the "Armored Scales," with a horny or dense wax-like covering or scale over their bodies, and those without such a covering, which the writer will designate as the "Unarmored Scales." The Armored scales include such common scales of citrus as purple scale, long scale, Flordia red scale, chaff scale, etc., and such scales as San Jose scale, white peach scale, palmetto scale and others, infesting many plants. The unarmored scales include the so-called soft scales and similar forms, the cushiony scales (including the cottony cushion-scale), mealy bugs and similar forms, and wax scales. While some of these, like the soft scales (soft brown scale, hemisphaerical scale, black scale, etc.) have no covering except the skin of the body others, like the cushiony scales, have cottony egg-sacs composed of wax-like material wholly or partly underneath the bodies of the mature insects. The mealy bugs generally have some powdery wax-like material or tufts of the same material on the bodies, sometimes completely covering them, and some of them deposit their eggs in small masses of such material isolated from their bodies. The wax scales have plates of wax covering the body.

Concomitant with the habits of insects that determine the two main classifications just indicated in the first paragraph, go two distinct methods of control. The biting insects may be poisoned by means of stomach poisons such as lead arsenate, Paris green, other arsenicals and poisons; sucking insects cannot be poisoned in this way but must be destroyed by liquids or dusts that kill by contact, such as oils, oil emulsions, soaps, sulphur compounds, tobacco extract, tobacco dust, pyrethrum or Persian insect powder, and others.

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*This paper is a companion paper to "Some Florida Scale-insects", by Mr. C. E. Wilson, published in this number of The Quarterly Bulletin.

The standard remedies or sprays for scale-insects are oil emulsions, soaps, and lime-sulphur. The formulas recommended will be given at the end of this paper. In the following paragraphs control measures for the several groups of scales, as also for several individual scales, will be discussed in more or less detail.

ARMORED SCALES

Of the Armored Scales, the control of the purple scale *(Lepidosaphes beckii)* and the long scale *(Lepidosaphes gloverii)* has probably been the most carefully worked out. While well defined broods of young scales, or "crawlers," are not generally recognized for these scales, nevertheless there are three periods during which crawlers are most abundant; March-April, June-July and September-October.

Since these crawlers are very easily killed, even by weak soap solutions, a good time to spray for these scales is when crawlers are abundant. Such periods can be better recognized, however, by frequent examination of the trees by means of a hand magnifier, during the months when the largest broods of crawlers are expected. This is important, because variations in the seasons produce variations in the time of the appearance of the crawlers. Whenever 2 or 3 crawlers per square inch of bark, leaf or fruit surface are visible, it is considered time to spray. The writer has, on the other hand, counted as many as 100 crawlers per square inch. Crawlers are minute and barely visible to the unaided eye as specks of whitish dust, but readily visible with a hand magnifier as minute insects frequently moving about. If the magnifier is an unusually good one, six legs and two antennae, so-called feelers or horns, may be seen on each crawler.

After a few hours of active life these crawlers permanently affix themselves to the tree by inserting their sucking beaks and beginning to feed. They assume a circular shape and soon secrete a bit of loose waxy material as a covering. In this condition they are known as "sets" and are still easily killed by even weak contact insecticides. After 18 to 20 days or, roughly, 3 weeks, the sets shed their skins and begin to form the permanent horny scale-covering, to which, however, the minute shed skin with its two horn-like projections remains attached, giving to young scales a rather characteristic appearance. Time for spraying is still good, but becomes less effective from now on as the permanent scale covering increases in size.

The preceding account of the development of the crawler from the time of hatching, during its first 18 to 20 days or, roughly, 3 weeks, gives the basis for the recommendation that, in order to get the best results, spraying for scales should be repeated every 2 or 3 weeks, until 2, 3 or even 4 sprayings have been made. Spraying as thus recommended has the effect of killing off each hatching of young scales before they reach a stage where they are difficult to kill. Theoretically considered, 4 sprayings at intervals of 3 weeks should completely eradicate the long and purple scales from a tree, since 12 weeks, or 3 months, is the average length of life of a female scale. Having killed off the young that hatched during each 3 weeks, no more females will be allowed to mature, and by the end of 12 weeks the mature females, having completed their egg-laying period and died, the work may be regarded as completed. It is not likely, however, that in actual practice 4 sprayings will always be made, except in nurseries, where complete eradication may be sought. Neither will complete eradication always be effected, since it is not always possible, practically, to reach all parts of a tree with a spray, while, on the other hand, the life-history period may be lengthened so that live scales and eggs will remain after the last spraying.

Finally, while the ideal time to spray for scales is while they are abundant in the first 3 weeks of their lives as crawlers or sets, approximately during March-April, June-July, September-October, it may not always be advisable to wait for the appearance of crawlers, but to spray when the trees need relief, with the strongest spray usable at the time, and then, if necessary, spray again, a second or third, or even a fourth time, at intervals of 2 or 3 weeks. As a matter of fact, most growers will be satisfied with 1 or 2 sprayings, especially if they were timed at all so as to be effective, preferring to spray again during the next year, and probably depending during part of the year, the period of summer rains, on the fungus parasites of these scales.

The least opportune time to spray is when most of the scales are in the egg stage, since eggs are even less easily destroyed by sprays than the mature scales. As it is not always easy for the average grower to determine in what stage of development his scale-insects are in, it is advised that he send an abundance of specimens, leaves, twigs, or fruit, to this Department, the Experiment Station, or Federal entomologists stationed in Florida, for examination. Specimens for transportation should be made into small packages carefully wrapped several times with paper, then packed in a tin or wooden box, and again wrapped in paper before mailing or expressing. These precautions are necessary in order to avoid the danger of crawlers escaping in transit.

The use of fungus parasites of these and other scales should not be omitted during the period of summer rains. A more detailed account of these fungi will be found towards the latter half of this paper. These may be started in scale-infested trees by tying pieces of twigs or bark, or leaves, having some one or all of these fungi upon them, onto the worst infested twigs and branches. The pieces need only be 2 or 3 inches long by about ½ inch wide, and should be so tied that the rains may wash the spores, or "seeds," of these fungi down over some of the scales. Should a grower decide to introduce a whitefly fungus at the same time, material of a scale fungus may be rubbed in water with a brush or a wet cloth and sand and mixed into the mixture of the whitefly fungus and water, and the whole sprayed into the trees.

The control by spraying of all other armored scales is practically the same as that indicated for the purple and long scales, but as the life histories of but few of them have been worked out as carefully, our recommendations cannot be so specific. Spraying should be started preferably when crawlers and sets are abundant, and repeated when they again appear, as often as necessary. Oil emulsions, soaps and lime-sulphur are the sprays recommended.

The spraying of deciduous trees infested with scales becomes considerably simplified. These are generally sprayed in winter when the trees are free from foliage and when a spray sufficiently strong to destroy all stages of the scale may be employed. The spray generally employed for trees without foliage is lime-sulphur solution. For San Jose scale, this is applied with best results just as the buds of the trees begin to swell. The strength employed for trees without leaves is 1 part to 7, 8 or 9 of water, or as directed by the manufacturer. When it becomes necessary to spray deciduous trees in full foliage, the insecticides must be used in much greater dilution as indicated in the formulas.

Most, if not all, of the armored scales are more or less attacked by the several lady-beetles and one or two other predacious beetles known in Florida, or by a number of hymenopterous parasites; these latter are minute wasp-like insects.

Scales of the following genera are Armored Scales: *Aspidiotus, Aulacaspis, Chionaspis, Chrysomphalus, Comstockiella, Conchaspis, Cryptophyllaspis, Diaspis, Hemichionaspis, Howardia, Ischnaspis, Lecaniodiaspis, Lepidosaphes, Leucaspis, Parlatoria, Pseudoparlatoria,* and others.

UNARMORED SCALES

SOFT SCALES AND OTHERS. As previously explained, these scales have no covering of any kind over the body and when fully developed are much larger than any of the armored scales. Scales of the genera *Asterolecanium, Coccus, Eucalymnatus, Lecaniodiaspis, Lecanium, Kermes, Neolecanium, Saissetia* and *Toumeyella* are regarded in this paper as belonging to the soft scales. They are generally easily destroyed by spraying with oil emulsions or mixtures of soap and water, using the strengths indicated in the formulae at the end of this paper. It may often be necessary to spray a second time, after 2 or 3 weeks, in order to destroy the young scales or crawlers concealed under the old scales at the time of the first spraying or that hatch from eggs so concealed.

All of the so-called soft scales found in Florida are probably regularly parasitized by minute wasp-like insects belonging to the Hymenoptera. Parasites of this kind are regularly observed on many specimens received and appear to be generally sufficient to keep them under control. Thus, *Coccophagus lecanii* Fitch is very common on the soft brown scale.

Several species have also been found infected with a fungus of the genus *Aschersonia* that greatly assists in keeping them under control. The fungus found on the soft brown scale and hemisphaerical scale may have been either the *A. turbinata* or *A. cubensis.* At the time the observations were made the fungus infecting these scales was supposed to be the *A. turbinata,* but it may have been the *A. cubensis.* This last named fungus has recently been observed at Gainesville almost completely eradicating a severe infestation of the liriodendron scale *(Toumeyella liriodendri* (Gmel.)*)* on banana shrub, and more recently at Oneco severely infecting the palm or tessellated scale.

CUSHIONY SCALES. These scales are also large, and as stated in the first part of this paper, the mature insects have some cottony material wholly or partly underneath them in which the eggs are deposited. This fact makes them more difficult to control, as insecticides do not always readily penetrate the cottony masses, or egg-sacs. The green shield scale, the pyriform scale, cottony maple scale, the rose palaeococcus and the cottony cushion-scale are listed under this topic for the purposes of this paper.

Oil emulsions and mixtures of soap are recommended as sprays for these scales, but as already indicated, the eggs being so well protected by the cottony material, it will always be necessary to repeat the spraying after two or three weeks and frequently again after another 2 or 3 weeks. Extra amounts of soap should be mixed with the oil sprays, and if soap alone is used it should be used strong, 15 to 18 lbs. per 50 gallons of water. Soap penetrates the cottony material better and also has the effect of sealing the eggs and young in it. The writer has in mind one grower who several years ago very successfully used the following mixture against cottony cushion-scale: 15 lbs. fish-oil soap, 3 quarts soda-sulphur and 1 gill thripjuice to 50 gallons of water.

Fortunately, most of these scales are heavily infested with other insect parasites and predacious insects so that spraying solutions are rarely needed. Thus the cottony cushion-scale is almost perfectly controlled by the Vedalia, or Australian Lady Beetle *(Novius cardinalis)*, which the Entomological Department of the Plant Board has been furnishing to growers during the past two years. The scale-eating caterpillars of two species of moths *(Laetilia coccidivora* and *Pyrodirus rileyi)* are regularly found feeding on the cottony cushion-scale. A small fly *(Cryptochaetum monophlebi* Skuse*)* introduced into California from Australia and found to be an effective parasite of cottony cushion-scale in that state, was received from the California Insectary, through the courtesy of Harry S. Smith, Supt., in March, 1917. Specimens of this fly were colonized at Stanton and near Winter Haven, Florida, but whether it has succeeded in establishing itself has not yet been determined.

The green shield scale is also regularly found abundantly preyed upon by the two caterpillars named in the previous paragraph. Besides these two caterpillars, a small black fly, *Leucopis nigricornis* Egger, has been abundantly reared from masses of this scale, of which it appears to be an effective parasite or predator.

MEALY-BUGS AND SIMILAR FORMS. Insects of this kind either have powdery wax-like material, or tufts of the same material wholly or partly covering their bodies. The eggs of some forms are also deposited in cottony material, thus frequently making it difficult to destroy the eggs and newly hatched larvae, or crawlers. Insects of the genera *Dactylopius, Orthezia, Pseudococcus,* and similar ones are included here.

Oil sprays and soap mixtures, preferably with tobacco extract, are recommended for these insects. But like with the soft scales and cushiony scales, spraying should be repeated in 2 or 3 weeks in order to destroy the young hatched from the eggs protected by the cottony material at the time of the first spraying. It is also considered important here to use extra quantities of soap in the oil sprays and to apply the spray with all the force possible, preferably with a nozzle that throws a strong central stream. This applies especially to the mealy-bugs proper, in order that the spray may be forced into the cottony material and the eggs and insects dislodged.

In California, a kerosene-lime mixture (see end of this paper) has been found most efficient as a spray against mealy-bugs.

Water, when it can be applied as a spray sufficiently strong to dislodge the mealy-bugs and the cottony masses containing the eggs, is a very good remedy.

Mealy-bugs do not often become a pest in Florida and the presumption is that other insects or fungus diseases keep them in check but, for some reason or other, the facts in the case have not been sufficiently investigated. Recently, Prof. Watson, of the Experiment Station, has received colonies of the Sicilian mealy-bug parasite, *Parleptomastix abnormis,* from California, which he has colonized in different parts of Florida.

WAX SCALES. The largest of these scales, the Japanese wax scale, is about ¼ inch in diameter. Two others, the Florida wax scale and the barnacle scale, also found in Florida, are not so large. They are covered with wax, generally arranged in plates, and rather soft as compared with the horny wax-like material covering the armored scale insects.

The writer is not aware that spraying on account of these insects has ever been carried on, and is probably rarely necessary. When necessary to spray, 3 or 4 sprayings at intervals of two or three weeks, with oil emulsions or mixtures of soap and water will probably be needed. It is the writer's belief that, due to the covering of wax, only the crawlers and immature scales with incomplete coverings of wax can be killed by spraying, which fact will necessitate successive sprayings until the old scales have died and no more eggs and young are produced.

Exit holes of internal parasites have occasionally been observed on these scales, indicating at least some degree of control by these insects.

Of fungus parasites, the turbinate aschersonia *(Aschersonia turbinata)* has been repeatedly observed by the writer as a most effective destroyer of the Florida wax scale.

FUNGUS PARASITES OF SCALE-INSECTS

Florida is peculiarly fortunate in having a number of fungi that generally very effectively control the scale-insects which they attack. There are six principal fungi that infect scale-insects, besides five others that destroy only whiteflies.

At present none of the scale fungi are being grown in artificial cultures like the Red Aschersonia, one of the principal parasites of whiteflies, so that growers must still depend upon getting supplies of such fungus material from trees and groves in which it occurs. When getting such supplies of fungus material growers must be on the lookout so that they do not get material from diseased groves and in that way introduce a new disease. As a rule, it will be best to first consult with inspectors of the Plant Board, or directly with the Plant Commissioner, as to whether it is safe to get fungus from any certain groves or localities.

The scale fungi are generally introduced into scale-infested trees by tying pieces of twigs, bark or other material, having fungus upon it, onto the limbs where the scales are most abundant in such a manner that rains will wash the fungus spores down over masses of scales. The pieces of fungus material employed need not be larger than 2 or 3 inches long by ½ inch wide. The amount of fungus used may be regulated by the amount available, but the more the better. The period of summer rains is the proper time in which to introduce fungus.

The scale fungi may also be introduced by thoroly rubbing up fungus material in water in such a manner as to liberate the spores and then spray the mixture of spores and water into the scale-infested trees. Fungus material may be rubbed fine and the spores liberated either by brushing it in water with a stiff scrubbing brush or rubbing it with a wet cloth and some sand. In case a whitefly fungus is also being introduced, the scale fungus material in water may be added to the spores and water mixture of the whitefly fungus, and the whole sprayed into the trees at one time. Such mixtures of fungus and water must, of course, first be strained thru fine wire gauze or coarse cheesecloth in order to strain out all coarse material liable to clog the nozzles.

No grower can make a mistake by introducing any or all of the scale fungi, provided, of course, he has the scales on which they thrive; and thruout a series of years they will undoubtedly save many spraying bills.

RED-HEADED SCALE FUNGUS. This fungus *(Sphaerostilbe coccophila* Tul*)* has been known as an effective parasite of certain scale-insects in Florida and other Gulf States for many years, and occurs in several other parts of the world. As the name indicates, the fungus develops small brick-red heads from the sides of the infested scales. These heads are approximately ¼ the size of a pinhead, spindle-shaped, and consist of a bunch of spores, or "seeds," of the fungus.

This fungus has been found destroying the following scales: purple scale, long scale, San Jose scale, oleander or chinaberry scale, chaff scale, red maple scale, California red scale, and the latania scale. This is not a complete list, but includes only those scales on which it is commonly found.

WHITE-HEADED SCALE FUNGUS. This fungus *(Ophionectra coccicola,* E. & E.*)* is undoubtedly equal, if not superior, in efficiency to the red-headed scale fungus as a destroyer of the long, purple and chaff scales of citrus. It has about the same distribution as the latter and was observed in Florida as long ago as 1885 by the late H. G. Hubbard, of the Bureau of Entomology, U. S. D. A. Mr. Hubbard, however, supposed that it was a scavenger fungus, living on dead scales, instead of a parasite that actually destroyed live scales. There are grounds for believing that it was this fungus that saved the day for the citrus growers when in the 40's of the last century the long scale, then recently introduced, threatened the destruction of the orange groves about Mandarin and St. Augustine. All kinds of remedies had been tried, including whisky and aloes, but to no avail, but later the trees began to recover, which must have been due to the spread of parasites, fungus or insect, or both. The grounds for believing that the white-headed scale fungus was present then is the fact that Mr. Hubbard found it in the St. Johns River section, and because it appears to be the oldest on record (1885) in Florida.

In appearance it is quite like the red-headed scale fungus, but the heads and other growth are grayish-white instead of brick-red.

The following scales are destroyed by this fungus: the long scale, purple scale, and probably also the chaff scale.

THE BLACK SCALE FUNGUS. The black scale fungus *(Myriangium duriaei* Mont.) is another useful scale destroyer widely distributed in Florida. Its appearance on the trees, principally the bark, is like black spatter from a paint brush wet with black paint.

It occurs on the chaff scale, the purple scale, the long scale, the San Jose scale, and probably the snow scale of citrus.

THE PINK SCALE FUNGUS. This fungus is apparently a more recent arrival in Florida. At all events, it was not recognized as a separate species until December, 1912, when Professor P. H. Rolfs, Director of the Expt. Station, recognized it as different from the red-headed scale fungus, for which it had apparently been previously mistaken. It now occurs widely distributed in Florida and also in Japan where it was described by Miyabe and Sawada as *Microcera fujikuroi.* In appearance it is quite like the red-headed scale fungus but spreads out more about the edge of the scales thus forming a small red area about them. Its pink color is due to the presence of light colored hairs on the heads which obscure the deeper red underneath. These hairs are absent or scanty on the red-headed scale fungus.

It is particularly a parasite of the Florida red scale, but will also infect the purple scale. According to Prof. J. R. Watson, Fla. Expt. Sta. Report for 1914, it is far more effective on this scale than the red-headed scale fungus is on the purple scale. It has also been received on the California red scale in Florida, and the obscure scale of oak.

THE TURBINATE FUNGUS. *Aschersonia turbinata* is quite different in appearance from the other scale fungi. The visible portions consist of a short thick whitish stalk, approximately ⅛ inch long, sometimes branched, with a depression at the top. The inside of this depression is bright red when fresh, but faded when old.

This fungus is a common parasite of the Florida wax scale. It probably also infects others of the so-called soft scales, but there is some confusion in regard to this just now, as the Cuban Aschersonia (see next topic) has undoubtedly been mistaken for it.

THE CUBAN ASCHERSONIA. *Aschersonia cubensis* is probably more or less widely distributed in Florida, but was only recently (March, 1917) distinguished from *A. turbinata.* The identification was made by Dr. Thaxter, courtesy of A. T. Speare of the Bureau of Entomology, U. S. D. A. This fungus is not unlike the turbinate fungus, but, instead of a single or branched whitish stalk, it consists of a low dome about the size of, or larger than, the insect that it infects. Over the top and sides of this dome are a number of small cavities filled with the reddish or yellowish spores of the fungus.

It has so far been positively identified infecting the liriodendron scale and the palm, or tessellated scale, but it is believed that one or two others of the so-called soft scales may be hosts.

SOME CONTACT INSECTICIDES EMPLOYED AGAINST SCALE INSECTS.

YOTHERS' FORMULAS. These formulas were devised by Mr. W. W. Yothers, Field Agent of the Bureau of Entomology, U. S. Dept. of Agriculture, stationed at Orlando, Fla., and were intended primarily for spraying the whitefly, but they are also excellent for spraying all kinds of scale-insects. The formulas are simple and no heat is necessary, except for the last one, in order to get the ingredients to combine.

Mix 2 gallons soft fish-oil soap and 1 gallon water.

To this mixture of soap and water, slowly add 3 gallons Diamond Paraffine, Junior Red Engine or other lubricating oil, 24 to 28 degrees Baume, at the same time stirring the mixture vigorously, or pumping it back into itself several times until all the oil is emulsified.

The product is the stock solution which has a thick cream-like consistency. For spraying citrus trees, dilute stock solution at the rate of one gallon to 50, 60, 70, 80, 90, or even 100 gallons of water. For spraying during May, through summer and early fall, use the mixtures, 1 in 70, 80, 90, or 100. For late fall, winter, and early spring, the stronger mixtures, 1 in 50 or 60. For spraying dormant deciduous trees without foliage, the mixture may be used as strong as 1 in 10. On deciduous trees in foliage, and other tender plants the mixture should be used very weak, and even then it is best to first experiment on a few plants.

Mr. Yothers also devised the following formula, which contains less soap and is cheaper, but requires more stirring to prepare the stock solution.

Fish-oil soap, 1 gallon.
Water, 1 gallon.
Oil as previously indicated, 2 gallons.

Prepare and dilute for spraying as indicated in the first formula.

Yothers' "New Formula" contains still less soap, but requires heat in its preparation. The proportions of the ingredients are as follows:

Fish-oil soap, or laundry soap, 2 lbs.
Water to make 4 gallons of stock solution, about 1¾ gals.
Oil as in the other Yothers' formulas, 2 gals.

This mixture must be heated to the boiling point, preferably over an open fire in order to avoid accidents of fire to buildings, and then agitated as directed in the first formula. for spraying, it is diluted as directed for the first formula.

Any other kind of soap can probably be substituted for the fish-oil soap in all of these formulas, but hard soap must first be dissolved in hot water.

If the water to be used for diluting the stock solution is hard, so that free oil rises to the surface when some of the stock solution is added to it, it will be necessary to first soften it by adding soap until it begins to lather and feel decidedly slick to the hands.

Lye, washing soda and borax are sometimes recommended for softening water, but are not always reliable because they do not neutralize all water-hardening minerals.

PROPRIETARY MISCIBLE OILS AND EMULSIONS. There are several of these on the market that give excellent results, but like the Yothers' formulas, if hard water causes free oil to rise to the surface, this must first be softened by the addition of soap. One to four pounds of soap to 50 gallons of water will generally be found sufficient.

SOAPS. Soap solutions are very good insecticides. While fish-oil or whale-oil soap is generally recommended and used, any other soap may be just as good. The writer has used laundry soap successfully. When there are only a few trees or plants to be sprayed, a few bars of laundry soap, always available, may be used. One pound of soap to five or six gallons of water will be found strong enough during periods of warm weather,—in May, through the Summer, and early fall. For spraying scales and whiteflies during the late fall, winter and early spring, or during the cooler parts of the year, one pound of soap to three or four gallons of water may be used. There is very little danger that one pound in five or six gallons of water will cause any injury to fruit or foliage, but the stronger solution, one pound to three or four gallons of water, may cause some injury when applied to trees with fruit and tender foliage. One pound of soap to 10-15 gallons water is sufficient for such soft-bodied insects as plant lice and flower thrips, especially if some tobacco extract is added.

KEROSENE EMULSION. This is an old standard remedy long employed against many kinds of sucking insects. It is convenient to make because the necessary ingredients are generally at hand, but may injure foliage if carelessly made and applied. In recent years it has been largely superseded by Yothers' formulas and commercial oil sprays. Dissolve ½ lb. soap (a little more if soft soap) in a gallon of hot water. Bring the mixture of soap and water to boiling and then, away from the fire, add 2 gallons of kerosene and begin to stir vigorously at once. Continue to stir until a smooth creamy mass, that will not separate, is the product. If a bucket pump is at hand the mixture may be pumped several times back into itself instead of stirring. This mixing process may require 5 to 15 minutes. For use on dormant trees and shrubs dilute the emulsion with 5 to 7 parts of water; for use on growing plants with 10 to 15 parts of water. Kerosene emulsion is much safer if applied on bright breezy days, not scorching hot, as that facilitates evaporation. The weakest solution is strong enough for plant-lice, and other soft-bodied insects; the strongest on dormant trees for scale-insects.

KEROSENE-LIME MIXTURE. This mixture is highly recommended in Bul. No. 258, Calif, Expt. Station, as a spray against mealy-bugs, and is here reproduced verbatim from that bulletin.

"Kerosene (42 degrees Baume), 20 gals.
Unslaked lime, 40 lbs.
Water, 200 gals.

"In preparing the mixture the lime is gradually slaked in a barrel or other convenient receptacle and thoroughly mixed to a creamy consistency. For convenience in handling, a mixture of one pound of lime per gallon of water should be used. The necessary quantity of this material should then be strained and placed in the tank, the kerosene and sufficient water to cover the agitators added, and the engine started. Three or four minutes will be sufficient to bring about a thorough emulsification. In case the mixture is permitted to stand for some time, the lime and kerosene which it has absorbed will sink to the bottom of the tank and a thin layer of frothy lime will appear on the surface. The emulsion, however, is stable and requires only agitation to be ready for use.

"The use of lime as the emulsifying agent instead of soap was found to increase considerably the penetration of the waxy covering of the mealy bugs. Where large egg masses are found upon the fruit and twigs, the penetration will not be complete by the first application, but a thin crust of lime will be formed over the surface, which will prevent the exit of the young mealy-bugs from the navels of the oranges. The white coating of lime deposited over the entire tree brought out strongly the fact that in field spraying as ordinarily practiced the uppermost branches in the center of the tree were very often left unsprayed, and as a result the possibilities of a rapid reinfestation were very good. The presence of some indicator in the spray is particularly desirable in mealy bug control work, where application to every portion of the tree is a prime necessity."

LIME-SULPHUR SOLUTION. Proprietary, or boiled lime-sulphur, when diluted 1 to 40-75 with water will destroy young scales, but its use in such weak dilution for this purpose alone is not advised. Lime-sulphur, in weak dilution, is the standard remedy for mites, and whenever it is necessary to spray for these, and it is also possible to time the spraying to catch a brood of young scales, this should be done.

It is not considered good practice now to undertake the boiling of lime-sulphur at home unless large quantities are needed, hence directions for boiling it are not included in this paper.

Diluted 1 part to 7, 8 or 9 of water, it is the standard remedy for San José scale on peach and other deciduous trees in the dormant leafless, or winter condition. It may also be used against other scales on dormant deciduous trees.

The proportions just indicated for the application of boiled, or proprietary, lime-sulphur are assumed to be based on stock solutions having a Baume test of 32 degrees. (It will suffice here to explain that *"degrees Baume"* refers to readings on the Baume hydrometer, a glass instrument used for testing the density of liquids.) But as different brands of lime-sulphur and home-made solutions may have quite a wide range of density, the following table is included, from which the proper amount of water to be added to any stock solution, or concentrate, testing otherwise than 32 degrees, may be ascertained.

Thus, if the stock solution tested 30 degrees Baume, and a spray solution of 1-75, based on a stock solution of 32 degrees Baume is desired, the middle figure, 69, in the next to the last column gives the number of parts of water to be added. In order to be accurate, on the one hand, and on the other hand to know that proper value is being received for his money, a grower should obtain from the dealer or manufacturer the degrees Baume, or density, of the product bought, or should obtain a Baume hydrometer and make his own tests.

(The table here given is copied from Bulletin 289, Agric. Expt. Station of Cornell University.)

"Table 8.—Showing the Corresponding Number of Dilutions of Lime-Sulfur Solution of Various Densities Using 32 degrees Baume as a Standard.

Degrees Baume	Specific gravity	1-10	1-15	1-20	1-25	1-30	1-40	1-50	1-60	1-75	1-100
25	1.208	7.4	11.0	14.7	18.4	22.1	29.5	36.8	44.2	55.0	73.0
26	1.218	7.7	11.6	15.4	19.3	23.2	30.9	38.6	46.3	58.0	77.2
27	1.229	8.1	12.1	16.1	20.2	24.3	32.4	40.5	48.5	60.6	80.7
28	1.239	8.4	12.7	16.9	21.1	25.4	33.8	42.3	50.7	63.5	84.5
29	1.250	8.8	13.2	17.6	22.1	26.5	35.3	44.2	53.0	66.3	88.2
30	1.261	9.2	13.9	18.4	23.0	27.6	36.9	46.1	55.3	69.0	92.0
31	1.272	9.6	14.4	19.3	24.0	28.8	38.4	48.0	58.0	72.0	96.0
32	1.283	10.0	15.0	20.0	25.0	30.0	40.0	50.0	60.0	75.0	100.0
33	1.295	10.4	15.6	20.8	26.0	31.2	41.5	52.0	62.4	78.0	104.0
34	1.306	10.8	16.2	21.6	26.8	32.4	43.2	54.0	64.7	80.8	108.0
35	1.318	11.2	16.8	22.4	28.0	33.4	44.9	56.0	67.4	84.2	112.0

"Note.—The figures in the columns indicate the number of times the concentrate of a given density is to be diluted to give a dilution equivalent to that at top of column."

TOBACCO EXTRACT. While tobacco extracts are used mainly against such soft-bodied insects as aphids and thrips, they have also been found useful against mealy-bugs, especially in greenhouses. There are several commercial extracts available, including a 40% nicotine sulphate solution. Directions for application are given on each package, but 2 to 6 lbs. of soap should always be added to each 100 gallons of spraying solution. Much more soap may be used when it is deemed desirable or necessary to do so, or the prescribed amounts of tobacco extract may be added to the soap and water mixtures recommended under Soaps.

A home-made tobacco decoction useful against soft-bodied insects on many plants can be made by boiling a pound of tobacco, tobacco dust, leaves or stems, in two or three gallons of water until a dark-brown liquid is obtained. The decanted liquid may be used alone, or diluted to make double the quantity and soap added at the rate of 1 oz. per gallon. The soap makes it adhere better and spread more evenly, and besides, soap is a good insecticide by itself.

SWEET POTATO ROOT WEEVIL

Wilmon Newell

For a number of years the sweet potato crop in certain sections of the South has been severely injured and, in many cases, totally destroyed by an insect known as the sweet potato root-weevil *(Cylas formicarius* Fab.*)*. In Louisiana the pest has been known since 1877 and considerable areas in southern Louisiana and southern Texas have become infested with the result that in many localities the growing of sweet potatoes on a commercial scale has been abandoned. The insect has also appeared at other points in the Gulf States, including a number of counties in Florida. The manner of introduction into Florida is not definitely known but from the fact that Cuban sweet potato tubers and plants infested with the weevil have freuently been intercepted by the Plant Board inspectors at Tampa and Key West, there is no doubt but what shipments of infested material from Cuba have been to a large extent responsible for the insect becoming established in this State. The lower East Coast in particular, because of steady commercial intercourse with Cuba, doubtless received its first weevils in shipments of sweet potatoes from the West Indies.

The 1915-'16 sweet potato crop of Florida amounted to 3,859,107 bushels, valued at $2,426,397.00*. Any insect capable of making serious inroads on this crop can, therefore, if it becomes generally distributed over the State, easily cause a direct loss to the farmers of a million dollars annually. Indeed, the acreage during the present season is unquestionably much greater than in previous years and it is a safe prediction that the Florida sweet potato crop of 1917-18 will exceed $3,000,000 in value. As will be shown below, the very existence of the sweet potato as a commercial crop in Florida will ultimately be threatened by the weevil unless energetic steps are taken to suppress it.

HISTORY

The insect was first described by Fabricius in 1798. According to Conradi*, "the insect was not regarded as a sweet potato enemy until 1857 when Nietner recorded it as attacking sweet potatoes in the Island of Ceylon in 1856. Among the earlier entomological writers, Fabricius refers to it from India and Tranquibar, Boheman from the East Indies and Java, and Dejean from the Isle of France."

According to Comstock†, Le Conte reported it from India and Madagascar, as well as Cuba and Louisiana. Its occurrence in Guam was reported in the Experiment Station Record, Vol. XXVIII, No. 2 (1915).

The Federal Horticultural Board gives the following additional countries as being ones in which this weevil occurs: Haiti, Jamaica, British Guiana, China, Friendly Islands, Sumatra, Formosa, Philippine Islands, Australia and Liberia.

According to Chittenden*, the native habitat of the insect is credited to Cochin China, and he is certain that it is at least of Oriental origin. Opinions differ as to whether the insect was first introduced into Cuba or into Louisiana. In a recent conversation with the writer, Doctor Chittenden expressed the opinion that New Orleans was the first point of introduction and that from Louisiana the pest had spread to the West Indies as well as to other Gulf States, and that the infestation in southeastern Florida had probably come from Cuba. The insect was first noticed in the United States near New Orleans in 1877, at which time it was claimed that it threatened the destruction of the sweet potato crop, which prediction later on was fully verified.

The earliest record of the insect's occurrence in Florida seems to be that contained in the Report of Prof. J. H. Comstock, Entomologist, in the Report of the (U. S.) Commissioner of Agriculture for 1879, in which Prof. Comstock gives an account of receiving specimens of the "sweet potato borer" from Mr. J. W. Curry, of Manatee, Fla., on July 8, 1878, with the statement that "it seems to threaten the destruction of the sweet potato crop in this county". Prof. Comstock continues: "Mr. Curry was unable to give details respecting the habits of the insect, as he received the specimens from a planter residing some distance from Manatee. February 20, 1880, I visited the locality in question hoping to be able to make a thorough study of the pest. But I found that Mr. Gillett, the planter referred to above, had dug his sweet potatoes a few days previous on account of the ravages of this insect. I was informed that the injury caused by this beetle was very great. In some fields nearly the whole crop was said to be destroyed."

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* Bulletin No. 93, Texas Experiment Station.
† Report of the Entomologist; Report U. S. Commissioner of Agriculture, 1879, p. 249.
* "Insects Injurious to Vegetables", p. 285, 1912.

Although the Plant Commissioner and his assistants were aware of the published account, quoted in part above, regarding the weevil having been found in Manatee County as early as 1878, it was impossible, on account of all energies being directed to the immediate subjugation of citrus canker, to make any investigations regarding the sweet potato root weevil until the summer and fall of 1916.

In January, 1917, Mr. Arthur C. Mason, then Assistant Entomologist of the Plant Board, was sent to Manatee County to see if the pest still occurred there. Fortunately, he found that Mr. Curry was still living and, being favored with an interview with him, learned that Mr. Curry was postmaster at Manatee in 1879 and sent the first specimens of the insect to the Department at Washington; also that in 1878 the weevils ruined his entire crop. He also located for Mr. Mason the farm formerly owned by Mr. Daniel Gillett, on which the potatoes were severely infested with the weevil in 1878-'79. This farm, located 8 miles north of Palmetto, is at present owned by Mr. Frank C. Armstrong. Mr. Armstrong clearly recalled the damage done by the pest and also described the appearance of the insect in large numbers "10 or 12 years ago". According to Mr. Armstrong, in both instances a few of the insects were noticed the first year and then the following year they were thick and ruined the crop. The third year no one tried to raise potatoes and "after that they disappeared". Mr. Lee Armstrong, residing in the same neighborhood, also remembered the "potato bugs" well, stating that they were present for several years prior to 1895, and were worst in 1893 and 1894 just before the big freeze, but that after the freeze they disappeared.

Inspection was made by Mr. Mason of a considerable number of fields in the community and, strangely enough, no traces of the weevil were found.

It seems very difficult to account for the apparent disappearance of the pest in the vicinity of Manatee. No such incident has, so far as known, ever occurred in southern Louisiana and Texas where the pest has occurred for many years and no natural enemies of the weevil are known which are of consequence in reducing its numbers. Opinion of the planters in the Manatee section seemed to be divided as to whether the weevils were killed by the "big freeze" or whether they were exterminated by all farmers ceasing the cultivation of sweet potatoes entirely whenever the pest became so abundant as to destroy the crop. Towards the latter opinion Mr. Mason also inclined. If this is the real explanation it indeed points toward the thorough practicability and comparative ease of eradicating the pest from any given area, a point which is discussed on a subsequent page.

The first report of the appearance of the pest in Texas was in 1890. Since the latter date, reports of serious damage to sweet potato crops in the infested sections have been frequent. The insect has not been thoroughly studied by entomologists. Perhaps the most complete publication regarding it is Bulletin No. 93 of the Texas Experiment Station by Prof. Albert F. Conradi, formerly State Entomologist of Texas. Professor Conradi determined accurately the life history and the essential facts regarding the habits of the insect under Texas conditions. There remains, however, much information to be desired as to the habits of the insect under varying climatic conditions and during different seasons of the year.

DISTRIBUTION IN FLORIDA

The sweet potato root-weevil has been known in Dade County for several years and sweet potatoes are not grown to any considerable extent in that county, although occasional patches are planted in gardens in an attempt to secure a few potatoes for table use.

Inspectors of the State Plant Board during the past year have found infestations by the weevil in the vicinity of Miami, Homestead and numerous other points in Dade County, at many places in Palm Beach County, including West Palm Beach, Lake Worth, Lantana, Hypoluxo, Boynton, Delray and Munyon's Island, at Ft. Lauderdale and Colahatchee in Broward County, Ft. Pierce in St. Lucie County and at City Point in Brevard County. It seems quite evident, therefore, that the entire East Coast strip of territory from City Point to Florida

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* Fourteenth Biennial Report, Fla. Dept. of Agr., p. 257.

City is more or less generally infested by the pest.* It is significant that the sweet potato crop throughout this entire area is very small, it being the exception that shipments of sweet potatoes are made from this territory to other points.

About Dec. 1, 1916, Prof. J. R. Watson, of the Florida Experiment Station, received specimens of the weevil from Mr. Wm. Dopson of Sanderson, Baker County. Investigations by Inspector K. E. Bragdon in Baker County in June, 1917, revealed the presence of the weevil at Sanderson, Glen Saint Mary and Macclenny. Apparently the starting point of this outbreak was near Sanderson, for at this point farmers were found who stated that they had noticed the insect for the first time three seasons before. On the farms where the insects had been noticed for three seasons, Mr. Bragdon found that the crop of 1916 was so badly damaged as to cause the farmers to discard from 30 to 50 per cent of the crop at the time of digging, and potatoes from the 1916 crop which were placed in storage were entirely ruined by the weevil before the spring of 1917, despite the care used to discard all potatoes seen to be infested at the time of digging.

Mr. A. L. Chandler of Homestead reports the occurrence of the insect at Cape Sable.

Investigations recently made by Mr. Bragdon show the presence of the insect in large numbers on Sanibel Island, Captiva Island and Buck Key in Lee County, although inspections have thus far failed to reveal the presence of the pest on the mainland in Lee County.

On August 30, 1917, Inspector H. B. Barnett discovered the weevil in one potato field near Citrus Park, Hillsborough County. Steps were at once taken in cooperation with the owner to eradicate this infestation. The work, which was carried out under the direction of Inspector E. R. Potter, is believed to have been successful, hence the writer does not feel that Hillsborough County, for the present at least, should be regarded as having infested territory within its borders.

DESCRIPTION

The adult insect is a weevil or "snout beetle", elongated in shape, smooth and glossy. The head is black, the thorax (middle section of the body) and legs are bright brick red, and the abdomen (posterior half of the body) is a beautiful dark steel-

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*Since the above was written Inspector Walter O. Lahrman has found infested areas at Daytona, Volusia County.

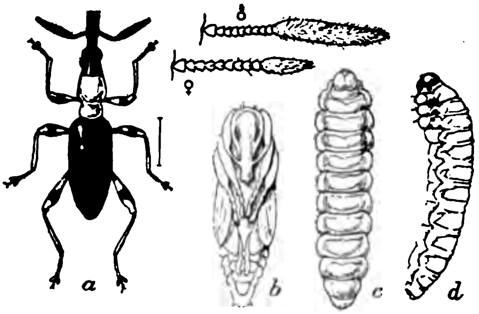

Fig. 71.—The Sweet Potato Root Weevil, *Cylas formicarius* Fab.: *a*, male beetle; ♂, antenna of male, enlarged; ♀, antenna of female, enlarged; *b*, pupa; *c*, larva, dorsal view; *d*, larva, side view—all enlarged. (After Chittenden, U. S. Dept. of Agriculture.)

blue. The adult is about one-fourth of an inch long and at first appearance is often mistaken for a large ant as it is ant-like in shape. The adults have only rarely been observed to fly although they possess fully developed wings, a fact established by both Prof. A. F. Conradi and Dr. E. W. Berger. Prof. Richard T. Cotton observed the beetles in flight at night in Porto Rico*. The weevils are able to walk and run about, but as a rule they do not run so rapidly that one cannot catch they readily with the hands.

Prof. Patricio Cardin, of Santiago de las Vegas, Cuba, has told the writer of finding one of these weevils flying around a light at the Experiment Station there.

The eggs are very small, yellowish white in color, and from one-fortieth to one-fiftieth of an inch in diameter. They are laid in cavities made by the female insect either in the vines or the tubers. When in the vines they are usually laid in the lower portions.

From the egg there hatches a minute, white, footless grub having a pale brown head. If in the stem when hatched, these grubs begin to feed and tunnel, usually towards the tuber. When tunneling in this direction, the tuber is eventually reached. Mr. Bragdon has noted cases, however, in which the grub was evidently proceeding in the opposite direction, and has found both larvae and pupae in infested plants in such a position as to indicate that it was not necessary for them to reach the tuber at all in order to complete their development. Conradi, on young plants without tubers, observed them develop successfully in the stem, "eventually killing the plant." If the eggs have been laid in or on the tuber itself, the grubs tunnel directly into the tuber and within a short time riddle it with numerous tunnels and galleries which soon become filled with excrement and decaying matter. The full-grown grub is from one-fifth to one-half inch in length. Upon completing its growth the grub or larvae changes into the pupal or transformation stage (which corresponds to the cocoon stage of a butterfly). In this stage the insect is not active and does not feed, and indications of legs, antennae and wings make their appearance.

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*Journal of Economic Entomology, Vol. 9, p. 516 (1916.)

LIFE HISTORY

Professor Conradi made careful studies of the developmental stages under Texas conditions and found the following:

The egg hatches in from 5 to 6 days after being deposited. Approximately 15 days are required for the larvae to complete its growth, and the pupal stage lasts about 8 days, making a total of 28 to 29 days for the complete development of the insect

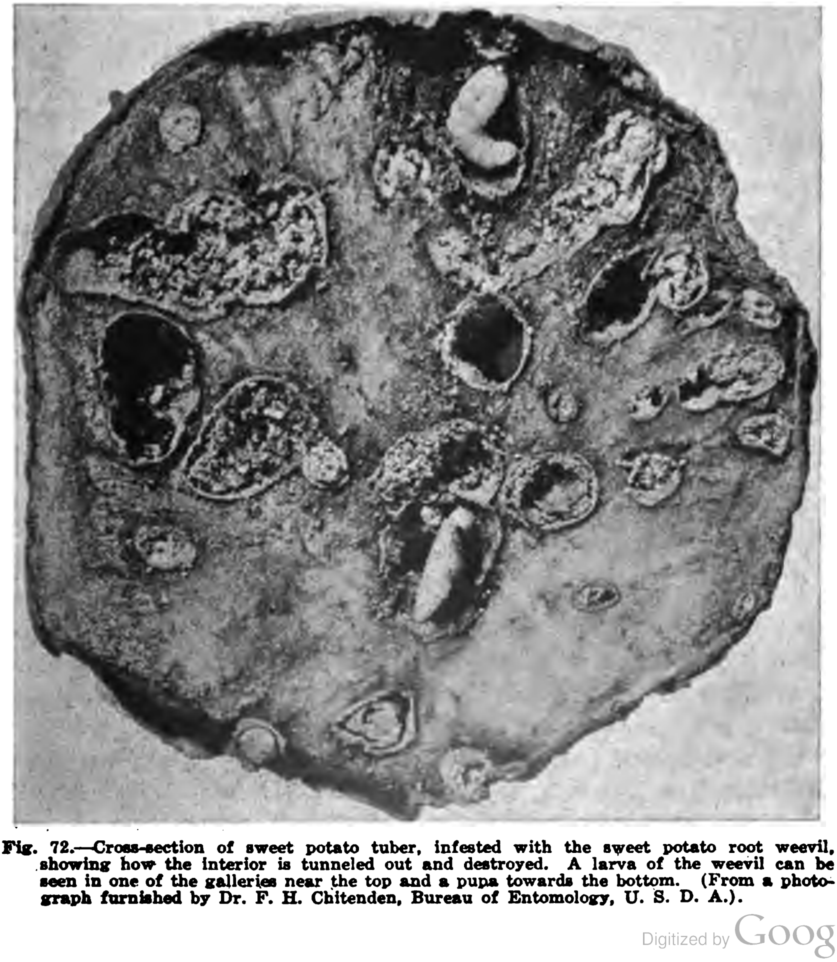

Fig. 72.—Cross-section of sweet potato tuber, infested with the sweet potato root weevil, showing how the interior is tunneled out and destroyed. A larva of the weevil can be seen in one of the galleries near the top and a pupa towards the bottom. (From a photograph furnished by Dr. F. H. Chitenden, Bureau of Entomology, U. S. D. A.).

from egg to adult. Making allowance for a brief period between the maturing of adults and the laying of the first eggs, it is seen that a generation is produced about once every 35 days. Mr. Conradi states that during the winter season the time required for development, from egg to adult, on account of lower temperature, is increased by about fifteen days' time.

Assuming that a generation is produced in an average time of thirty-five days, there are at least eight broods during the course of the year. In Florida the temperature during most of the winter is high enough to permit of the uninterrupted development of the insect and breeding continues steadily in stored potatoes or in potatoes left in the field during the winter months. It would be safe indeed to estimate that fully seven to eight broods are produced in northern Florida during the year and ten or eleven broods in the extreme southern portion of the Peninsula.

As the period during which the female deposits eggs continues anywhere from two to twenty-one days, it naturally follows that there are no distinct generations but weevils in all stages from egg to adult may be found at almost any time. The rapidity of development, coupled with a mild climate which permits uninterrupted development throughout the year, explains why the pest is so destructive under Florida conditions.

Experiments made by Conradi indicated that during the summer adult weevils can live without food for as much as seven days, and during winter for as much as thirteen days. However, the length of adult weevil life in the absence of food is not of particular consequence, inasmuch as weevils in the field are able at all times to find vegetation upon which they can feed.

HOST PLANTS

The sweet potato and morning-glory are the preferred plants for feeding purposes, although the adult weevil is able to feed upon a great variety of vegetation. Conradi was able to keep the weevils alive for fifty-five days when they were fed upon buckwheat and for at least twenty-eight days when fed on melons. So far as known, experiments have not yet been made to determine how long the adult weevils can live if furnished with sweet potatoes upon which to feed. The sweet potato and morning glory and very closely related vines are the only ones in which the eggs and larvae have been found.

In September, 1917, Mr. Bragdon found the weevil heavily infesting the stems and roots of the "sea-bean" *(Ipoemea Pes-Caprae* (L) Sweet*)*, on Sanibel Island. On Captiva Island he found a plant, as yet unidentified*, the stems and roots of which were also heavily infested.

It seems not impossible that other plants belonging to the same family (Convolvulaceae) may be possible hosts. Such plants should at least be regarded with suspicion.

SUSCEPTIBILITY OF DIFFERENT VARIETIES

No variety of sweet potato has been found immune to the weevil, although Mr. E. R. Potter noticed in an infested field which contained both Porto Rico yams and Nancy Hall plants that the weevils were very much more abundant on the latter than on the yams. It is very doubtful if any variety of sweet potato is sufficiently resistant to make possible its profitable cultivation in the presence of a heavy infestation.

METHODS OF DISSEMINATION

Although the insect possesses well developed wings, it has in only one or two instances been observed to fly and the slow rate at which it spreads after being established in a community indicates that flight rarely if ever occurs. The principal means by which the insect is disseminated from one locality to another and from one farm to another is in the movement of infested sweet potatoes and sweet potato plants. There is no doubt but what the insect was first introduced into the Western Hemisphere from the Orient in infested potatoes and the distribution to various points in the Gulf States has been by the same method. That the insect has not already become generally distributed over the Gulf States is probably due to the fact that until recent years the sweet potato was largely a local crop, farmers as a rule not growing more sweet potatoes than could be used by local merchants or by near-by cities. In a similar manner, the farmer usually propagated plants from tubers of his own raising or secured plants from a near-by neighbor. Within recent years, following the introduction of new varieties and the supposed improvement of others, individuals have engaged in the business of growing sweet potato plants for sale. Dealers in plants have advertised their product through the agricultural press with the result that many thousands of plants are annually shipped by indi-

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*Probably a species of *Ipoemea*.

vidual dealers. It can readily be seen that if such a dealer were to ship infested plants he could be responsible in a single season for the pest becoming established in many new localities.

The shipment to market of infested tubers has also doubtless been responsible for much of the spread. Unless the potatoes are fumigated at the time of digging or before shipment the weevils continue to breed in them for an indefinite period. Strangely enough, farmers themselves sometimes buy sweet potatoes in the stores and if a farmer buys sweet potatoes and finds some of them infested by the grubs of the weevil, his first inclination is to throw them out for hogs or cattle to eat, thus affording opportunity for the insects to become established on his own farm.

NATURAL CONTROL

The sweet potato weevil seems to be singularly free from natural enemies. No parasite has thus far been found to attack the weevil and there are no observations on record of birds destroying them. Strangely enough, the insect appears to be one which finds the most favorable conditions for its development in the area lying within approximately seventy miles of the Gulf Coast and the Atlantic Coast. The insect is able to survive the winters and to continue breeding at points much more than seventy miles from the Gulf Coast, but at points more than seventy miles from salt water maximum injury to the crop is not experienced. This can hardly be due to a natural check on the weevil because of low temperatures during the winter. The weevil is able to withstand temperatures which ordinarily are not experienced except at points as far north as central Georgia and central Alabama. In his experiments with the weevil, Professor Conradi found that adult weevils successfully withstood a temperature of 20° for a period of thirty minutes. When adults were subjected to a temperature of twenty degrees for one hour, 84% of them were killed; and at a temperature of 10° for two hours all adults were killed. These experiments were of course made with the adults exposed to the degree of temperature mentioned. In the field many weevils would find protection in the sweet potato tubers or beneath trash or in the ground where, with an air temperature of ten degrees, the weevil would not experience a temperature much below freezing. There are no grounds, therefore, for believing that winter temperatures are responsible for the weevil not extending its destructiveness to areas more than seventy miles from salt water. Although it is well known that certain insects and certain plants habitually confine themselves to the same area in the coastal plain, the exact reason for this limitation of advantageous natural conditions is not clearly understood. There is no apparent reason for believing that the lowest temperature experienced, even in northern Florida, will serve as a natural check to the insect. The temperature experienced during February, 1917, when the temperature fell as low as eighteen degrees at Gainesville and even lower in northern portions of the State, was not sufficient to perceptibly reduce the number of weevils in Baker County. It is obvious that the sweet potato industry of Florida must depend upon so-called "artificial" methods for the control of this insect.

ARTIFICIAL CONTROL

The control of the pest may be considered under two distinct heads: that of preventing the further spread of the pest to new localities, and the reduction of damage to the crop in the areas which are already infested.

Quarantine Measures

During the past season, the State Plant Board was active in calling the seriousness of this pest to the attention of the growers and dealers who make a business of selling and distributing sweet potato plants. The Plant Commissioner urged upon such dealers the advisability of having their premises inspected by the Board's inspectors and the subsequent use of an inspection certificate upon all plants shipped by them, in order that their customers might know that they were not receiving plants from infested fields. A considerable number of progressive dealers availed themselves of this plan and as a result many thousands of certified shipments of sweet potato plants were made by Florida dealers during the spring and early summer of 1917. It is interesting to note, in this connection, that out of the dealers' plantings which were inspected two were found in which the sweet potato weevil occurred. These dealers did not afterwards ship plants.

The Plant Board has for several months seriously and carefully studied methods for preventing the spread of the weevil to those localities in Florida not yet infested. In the first place, experience showed that infested plants and tubers were being shipped into Florida from other states and countries. For example, the number of plant and tuber shipments arriving at Tampa and Key West from Cuba heavily infested with the weevil was a source of surprise and grave concern. All infested shipments arriving were of course refused delivery in Florida and were either returned to the original shipping point or destroyed by the Plant Board inspectors. However, this experience showed conclusively that there would be no use in attempting the control or eradication of the sweet potato root weevil in Florida unless the further shipment of infested material from other states and countries was stopped. It was self-evident that the Plant Board could not undertake to inform itself as to all infested and non-infested sections in the other states and in the West Indian Islands. The only way that the influx of infested material could be stopped was to adopt a quarantine measure which prohibited the further shipment of host plants of the weevil into Florida. Such a quarantine was inaugurated by the Plant Board on July 23, 1917, when it adopted the following rule:

> "Rule 32. In order to prevent the introduction of the destructive insect enemy of sweet potatoes, known as the Sweet Potato Root Weevil *(Cylas formicarius)*, the importation into Florida of all sweet potato tubers, sweet potato plants, vines, cuttings, draws and slips and of all morning glory vines, cuttings, tubers or roots is hereby prohibited: provided, that this rule shall not be construed as prohibiting the importation of canned sweet potatoes and provided, further, that the importation of limited quantities of new or rare varieties may be allowed by special permit of the Plant Commissioner under such safeguards and precautions as he may specify. Application for such permits must be made to the Plant Commissioner, Gainesville, Fla."

Preventing the further shipment of sweet potato root weevils into Florida with infested tubers and plants constituted of course only one step in preventing distribution, for the infested areas in Florida still presented a menace so far as the remainder of the State was concerned. A similar quarantine was placed on the infested Florida areas by action of the Plant Board taken on September 13, 1917, when rules were adopted prohibiting absolutely the movement of sweet potato plants out of any infested Florida locality and prohibiting the movement of sweet potato tubers out of infested Florida localities to non-infested areas unless first fumigated under the personal supervision of an inspector. The quarantine rules adopted by the Board September 13th, together with the Public Notice defining the infested Florida areas, are as follows:

> "Rule 33. The movement or shipment of sweet potato slips, draws, vines, plants and cuttings and of morning glory tubers, roots, vines and parts thereof, from the areas designated in the Public Notices by the State Plant Board as areas in which the Sweet Potato Root Weevil *(Cylas formicarius* Fab.) occurs or which are infested by said weevil, into or through all parts of the

> State of Florida other than those specified as infested areas, is hereby prohibited."
>
> "Rule 34. The movement or shipment of sweet potato tubers from the areas designated in the Public Notices of the State Plant Board as areas in which the Sweet Potato Root Weevil (*Cylas formicarius* Fab.) occurs or which are infested by said weevil, into all parts of the State of Florida other than those specified as infested areas, unless first fumigated under the personal supervision of an Agent of the Plant Board and certified by him, is hereby prohibited; provided, that this rule shall not be construed as preventing the shipment of sweet potato tubers from infested sections in the State of Florida to points in other states when such tubers are securely sacked and shipped in tightly closed cars in carload shipments and provided, further, that this rule shall not be construed as preventing the shipment of canned sweet potatoes."
>
> Public Notice
>
> "Under the provisions of the Florida Plant Act of 1915, Chapter 6885 of the Laws of Florida, the State Plant Board, in session at Jacksonville, Florida, this 13th day of September, 1917, and in accordance with Section 12 of said Act, does declare and give public notice thereof that the Sweet Potato Root Weevil (*Cylas formicarius* Fab.) is an insect pest the dissemination of which should be prevented, that sweet potato plants, vines, slips, cuttings, draws and tubers and morning glory (*Ipomoea* sp.) vines and roots are plants likely to become infested by said insect pest and that the following areas are areas within the State of Florida in which said insect pest is known to occur: the Counties of Baker, Brevard, St. Lucie, Palm Beach, Broward, Dade and Monroe and Sanibel Island, Captiva Island and Buck Key in Lee County."*

Under the foregoing regulations, farmers in the infested areas must find a market for their sweet potato crop either within these infested areas or in some other State, or must have their sweet potato tubers fumigated before shipping them to any non-infested section in the State of Florida.

Full compliance with the rules and regulations of the Plant Board by the farmers in the infested sections and precaution on the part of farmers in the non-infested sections to secure no sweet potatoes or potato plants from infested areas should materially check the further distribution of the pest. Those who have occasion to purchase sweet potato plants should insist imperatively upon their purchases being accompanied by the inspection certificate of the State Plant Board.

Fumigation

All stages of the weevil in sweet potatoes can, according to the experiments made by Conradi, be destroyed by fumigation of the tubers in a tight compartment, using three pounds of carbon bisulphide to each one thousand cubic feet of space, and keeping the compartment tightly closed for thirty hours. One condition to the success of the fumigation, however, is the use of a practically air-tight compartment in which the fumigation is made. For small quantities of potatoes a tight barrel such as an alcohol, formaldehyde or vinegar barrel, can be used. The potatoes are placed in the barrel, either loose or in sacks, a shallow vessel placed on top of them, and the requisite amount of carbon bisulphide poured into the vessel, and the top of the barrel covered with an oiled canvas* held in position by an extra barrel hoop driven down tightly over it. For fumigation of larger quantities an airtight room, safely removed from other buildings, is necessary. (Carbon bisulphide is inflammable and its vapor explosive; no fire or lights should be allowed near where it is stored or used.)

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*Since adoption of the above public notice infestation by the weevil has been found in Volusia County.—W. N.

Reducing Damage on Infested Farms

No entirely satisfactory means of controlling the weevil or eliminating the damage has been devised. There are certain steps, however, which the farmer can take to materially reduce the damage by the weevil. No one of the measures mentioned below is sufficient to insure even a small part of the crop being free from grubs and weevils, but a combination of all these measures, if generally employed throughout a community, or even on a single farm, will bring about a very noticeable reduction in the number of weevils and in the extent of damage. The control measures which have thus far been found useful may be summarized as follows:

1. Sweet potatoes should not be planted upon land in which sweet potatoes were grown the year before, and preferably each planting should be placed as far as possible from any other sweet potato patches. This makes it more difficult for the insects living through the winter to find the plantings in the spring.
2. The farmer should be sure that he is using plants which have come from a field or locality where the sweet potato root weevil does not occur.
3. No "hold-over" potatoes should be allowed to remain in the field during the winter. The custom of planting potatoes late in the season and leaving the tubers in the ground to mature early the following summer is a practice which affords the weevil a continuous supply of food and continuous breeding quarters throughout the entire season. This practice should be entirely abandoned in the infested areas.
4. As far as possible all morning-glories of every kind

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* The heavier the canvas used, the better. It can be rendered gastight by soaking for a short time in linseed oil, wringing out the excess oil, and then drying in some place protected from direct sunlight.

should be exterminated in the vicinity of potato fields. Roots of the morning-glory are as acceptable to the weevil for breeding places as are sweet potato tubers, and morning-glories, wherever found, should be dug out by the roots and the vines and roots burned. Use of morning-glories as ornamentals, in the infested areas, should be discontinued.

5. When the potatoes are harvested, extreme pains should be taken to secure every tuber in the field. All vines, damaged tubers, fragments of roots, etc., should be completely burned at time of harvest. The field should then be plowed and cross-harrowed, pains being taken to get every particle of potato, potato root or vine and these destroyed by burning. Hogs can then be turned into the field to hunt out any potatoes which have escaped the owner.

6. The field should be closely watched the following spring and if any volunteer plants appear, they should be at once dug up, tubers and all, and burned. As soon as the potatoes are dug they should be fumigated with carbon bisulphide to kill all weevil stages in them. If they are to be kept in storage on the farm, they should be placed in a compartment which has not been previously used for sweet potatoes (unless first thoroughly cleaned out and disinfected). This compartment should be screened for the double purpose of preventing weevils getting to the fumigated sweet potatoes and starting a new infestation in them and of preventing the escape of any weevils which might hatch in the potatoes themselves. This also serves as an additional check upon the efficiency of the fumigation.

7. Extremely early planting in the spring should be discouraged. Experience in Texas and Louisiana has shown that late plantings experience less damage than the early ones, probably because in the case of early plantings the insects have a longer time in which to reproduce and increase before tubers reach proper size for digging.

8. When planting use plants from a locality in which the weevil does not occur, and insist upon such plants, when purchased, being accompanied by the inspection certificate of the State Plant Board.

9. If necessary to produce home-grown draws in the infested territory, use only clean, sound tubers which have been fumigated and bed the tubers in a field or lot considerably removed from the main field. In other words, do not have beds or draws adjacent to the fields that are to be planted out.

10. Never throw out infested potatoes or potatoes which are

partly decayed or injured. All these should be burned up or, if it is desired to use them for feeding to stock, they should first be boiled, and any remnants left by the stock should be carefully gathered up and burned. It should be remembered that every particle of potato tuber, either above the ground or below it, outdoors or in, may become a breeding place for weevils which will attack the following year's crop.

Each farmer *in territory free from the pest* should raise enough potatoes for his own use throughout the year and thus avoid the risk of infesting his place by buying potatoes on the market.

Spraying

Experiments were made by Conradi in spraying vines with arsenical poisons in the attempt to kill the adult weevils. While these experiments were not extensive enough to justify the conclusion that the use of arsenical poisons would be found practical under field conditions, the possibility of using lead arsenate is at least indicated. The spraying of young vines with a lead arsenate mixture, 2 or 3 lbs. to 50 gallons of water should, in the absence of other food plants in the field, kill some of the adult weevils. This might prove a useful supplementary measure to the steps described above, especially early in the season while the plants are still comparatively small.

DAMAGE TO POTATOES IN STORAGE

At ordinary temperatures the weevil continues its work in stored tubers and the temperature during the winter months in Florida is rarely low enough to interfere with its development.

No careful experiments have been made to determine to how high a temperature tubers must be subjected in order to kill all weevil stages in them, but from what is known regarding the effect of heat upon other weevils it is a fairly safe conclusion that the tubers would have to be heated through and through to a temperature of at least 122 degrees F. and this temperature maintained for several hours. Tubers which have been kiln-dried or otherwise cured are not exempt from attack by the pest.

ERADICATION EXPERIMENTS

From the known habits of the sweet potato root weevil and the manner in which it is disseminated, it apparently would be possible to eradicate it much in the same manner that citrus canker is being now eradicated from the citrus groves of Florida. However, it is not the policy of the Plant Board to condemn infested fields but rather to, first, prevent further distribution and, secondly, to assist the farmers in the infested areas to reduce the pest as rapidly as possible—and perhaps wipe it out entirely—the farmers at the same time continuing the raising of sweet potatoes on as large a scale as may be desired. Where small isolated infestations occur it will undoubtedly be profitable, both for the owners and the community, to wipe out the infested fields at once.

The complete and immediate eradication of the insect, in large areas which are generally infested, would involve the expenditure of a considerable amount of money and would require in addition the full co-operation of all farmers and business interests. Whether such extensive steps will be taken by the Plant Board in the future will of course depend upon the extent to which the farmers in the infested areas demand this assistance and the extent to which appropriations are provided for the purpose. There appears no good reason, however, for believing that isolated outbreaks, consisting of a few infested fields, cannot be eradicated with a minimum of cost. An attempt of this kind has recently been made by the State Plant Board in Hillsboro County.

On August 31, 1917, Inspector Harry B. Barnett learned of the presence of the weevil in a potato field belonging to Mr. L. E. Mobley at Citrus Park. Mr. Mobley's field consisted of about one-fourth of an acre of sweet potatoes and there were no sweet potato fields nearer to it than half a mile. Inspection of the latter fields showed no weevils. Arrangements were immediately made with Mr. Mobley for an experimental attempt to eradicate the pest. The following methods were employed:

The entire potato field was sprayed with kerosene for the purpose of destroying any adult weevils crawling about on the vines and for reducing the chances of any escaping from the field during the subsequent operations.

All potato vines were cut and burned upon a log fire. The tubers were then dug with care, pains being taken to get all of the tubers and as many of the roots as possible. The tubers and the roots were also burned. The field was then plowed, inspectors following the plow and picking up all roots, pieces of stem, tubers, etc., and burning these. The field was then harrowed several times and the same cleaning and picking process continued until it seemed certain that every particle of sweet potato plant had been removed and burned.

The succeeding operations were divided into two parts. The first consisted of carefully examining all fields and premises in the vicinity for morning-glory vines, and wherever these were found they were uprooted and burned. In the field itself, immediately following the destruction of the plants and tubers and the plowing of the field, clean sweet potatoes (which came from an area not infested by the weevil) were used as "traps" for catching any weevils which escaped the general destruction of the potato patch. These clean potatoes were placed in various parts of the field, each potato being partially buried in the ground. It was assumed from the known habits of the insect that any weevils remaining in the field would be attracted to these potatoes. The subsequent program included daily visits to these potatoes and the destruction of any adult weevils found on them. During the nine weeks following the placing of these "traps," 169 adult weevils were collected from them. At the end of the first week these potatoes were taken up and burned for the purpose of destroying any eggs which had been deposited in them during the week. The plan calls for the continuation of this practice, that is, the replacing of the trap potatoes and their destruction weekly, for the remainder of the season.

While this work was in progress another field in the neighborhood was found on closer inspection to be very lightly infested. In the case of this field the same steps were taken.

As a part of this attempt to eradicate this weevil outbreak, the farmers whose fields are nearest to Mr. Mobley's will be asked at time of digging their potatoes this fall to fumigate these potatoes whether they show infestation or not, and to destroy completely all remnants of the crop, such as vines, stems, etc.

This experiment has of course been carried out largely on theoretical grounds, and the outcome of it will be watched with a great deal of interest by both the State Plant Board employees and by the farmers, for in case the experiment is successful and this infestation is eradicated, there is no reason why the same methods cannot be employed in the case of other sporadic outbreaks or even in localities where the infestation is quite extensive. If, on the other hand, the steps taken do not result in complete eradication of the weevil in that locality, there will be opportunity to inquire as to the reasons why it was not successful. Regardless of the results secured, the information will be of value in the future campaign against this pest.

FEDERAL RECOGNITION OF THE ERADICATION CAMPAIGN

The U. S. Department of Agriculture has fully recognized the dangerous nature of the sweet potato root weevil, as well as the practicability of undertaking its eradication on an extensive scale. On July 1, 1917, at a conference held between Dr. F. H. Chittenden, of the Bureau of Entomology, and the writer, Doctor Chittenden expressed the opinion that in the light of his knowledge of this insect, there was no good reason why it should not be completely eradicated from the United States provided the work were properly managed and a sufficient amount of money made available for the purpose. The matter was duly brought to the attention of the Honorable Secretary of Agriculture, David F. Houston, and as a result the sum of $10,000.oo has been set aside out of the sum allotted for the suppression of insects injurious to truck crops, available under the provisions of the Food Production Act, approved August 10, 1917, the $10,000.oo to be used by the Bureau of Entomology, U. S. Department of Agriculture, in preliminary survey work and demonstration methods in the states where the weevil occurs. It is to be hoped that this is only the beginning of a systematic attempt upon the part of state authorities in the Gulf States, in cooperation with the federal government, to completely dispose of this insect for good and all times.

LITERATURE

Following is a list of the principal publications regarding the sweet potato root weevil which have come to our attention. No attempt is made to include in this list all references to the species and where no information of practical interest is contained in a paper we have purposely omitted reference to it.

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NEWELL & ROSENFELD. Circ. 27, La. Crop Pest Commission, p. 104 (1909).
CHITTENDEN, F. H. Insects Injurious to Vegetation, p. 235 (1912).
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WATSON, J. R. Sweet-Potato Root-Weevils. Press Bulletin No. 284, Fla. Experiment Station (1917).
STATE PLANT BOARD OF FLA. Circulars 18, 20, 23 and 24 (1917).
BRAGDON, K. E. The Sweet Potato Root Weevil in Florida. Florida Buggist, I, No. 2 (1917).

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING SEPTEMBER 30, 1917

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending September 30th has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING SEPTEMBER 30, 1917

Citrus grove trees inspected	2,716,704
Citrus nursery trees inspected	10,234,981
Inspectors employed	322
New properties showing infection	2
Total properties showing active infection	22
Grove trees found infected	75
Nursery trees found infected	0
Counties in which active infections were found	7

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,704
Nursery trees found infected since May, 1914	342,254
Number properties infected to September 30, 1917	475

(This number includes seven (7) properties which have shown re-infection. When parts of infected properties have been sold the portion disposed of, when infected, is carried as another infected property under the name of the new owner.)

Properties declared no longer "danger centers"	340
Properties still classed as "infected" September 30, 1917	135

Note: A revision and tabulation of the records has necessitated some changes in this report as compared with preceding reports.

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to September 30, 1917:

1914		1915		1916		1917	
		Jan.	306	Jan.	86	Jan.	14
		Feb.	165	Feb.	21	Feb.	4
		March	444	March	49	March	9
		April	408	April	49	April	169
May	108	May	1042	May	338	May	52
June	160	June	772	June	450	June	45
July	275	July	651	July	349	July	39
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30
Sept.	767	Sept.	618	Sept.	124	Sept.	6
Oct.	565	Oct.	214	Oct.	451		
Nov.	773	Nov.	494	Nov.	131		
Dec.	366	Dec.	256	Dec.	27		

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING SEPTEMBER 30, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

SHIPS AND VESSELS INSPECTED:			
From foreign ports	351		
From U. S. ports other than Florida	211		
From Florida ports	406		
Total		968	
SHIPMENTS INSPECTED:			
Arriving by water:			
Passed	114		
Treated and passed	7		
Returned to shipper	19		
Detained, subject to return by shipper	1		
Contraband destroyed	232		
		373	
Arriving by express, freight, etc.:			
Passed	114		
Treated and passed	26		
Returned to shipper	24		
Detained, subject to return to shipper	23		
Contraband destroyed	9		
		196	
Total shipments inspected			569

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested.
Cactus scale	Cactus	Cuba	1
California black scale	*Eugenia malaccensis*	Cuba	1
California black scale	Sago palm	Cuba	1
Chaff scale	Citrus	Cuba	1
Citrus mealy-bug	Guava	Florida	1
Cocoanut mealy-bug	Cassava	Cuba	1
Cocoanut mealy-bug	*Ochrocarpos africanus*	Cuba	1
Cocoanut mealy-bug	Palm	Cuba	1
Crown gall	Rose	Cuba	1
Crown gall	Rose	Florida	1
Cyanophyllum scale	Palm	Cuba	1
Dictyospermum scale	Bahia	Cuba	1
Dictyospermum scale	*Eugenia malaccensis*	Cuba	1
Florida red scale	Citrus	Cuba	1
Florida red scale	Citrus	Florida	1
Florida red scale	Rose	Cuba	1
Florida red scale	Rubber plant	Florida	1
Hemisphaerical scale	Sago palm	Cuba	1
Lesser snow scale	Bahia	Cuba	1
Lesser snow scale	Palm	Cuba	1
Lesser snow scale	Cassava	Cuba	1
Long scale	Citrus	Cuba	1
Mango scale	Mango	Cuba	1
Mealy-bug	Rose	Cuba	1
Mealy-bug	Sago palm	Cuba	1
Melanose	Citrus	Cuba	1
Mining scale	*Casuarina stricta*	Cuba	1

Insect or Disease	Occurring on	From	Number of shipments infested.
Mining scale	*Jacobinia mohintli*	Cuba	1
Nematode root-knot	Fig	Cuba	1
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Spirea	Florida	1
Oleander scale	Brunfelsia	Cuba	1
Oleander scale	Japonica	Cuba	1
Oleander scale	Lantana	Cuba	1
Oleander scale	Mammee apple	Cuba	1
Oleander scale	*Ochrocarpos africanus*	Cuba	1
Oleander scale	Sago palm	Cuba	1
Papaya fruit-fly	Papaya	Florida	1
Pineapple scale	Pineapple	Cuba	1
Purple scale	Citrus	Cuba	3
Purple scale	Citrus	Florida	2
Red bay scale	Unknown plant	Cuba	1
Rufous scale	Brunfelsia	Cuba	1
Rufous scale	Citrus	Cuba	3
San Jose scale	Peach	Florida	1
San Jose scale	Peach	So. Carolina	1
San Jose scale	Rose	Florida	1
Soft brown scale	Acalypha	Florida	1
Soft brown scale	Chrysanthemum	Florida	1
Soft brown scale	Guava	Florida	1
Soft brown scale	*Pseuderanthemum*	Cuba	1
Sweet potato root weevil	Sweet potato	Cuba	4
Whitefly	Citrus	Alabama	1
Whitefly	Citrus	Cuba	2
Whitefly	Jasimine	Florida	1
Whitefly	Jasimine	So. Carolina	1
White peach scale	Bahia	Cuba	1

PARCEL POST PLANT INSPECTION

QUARTER ENDING SEPTEMBER 30, 1917

PARCELS INSPECTED:

Passed	119	
Treated and passed	0	
Returned to sender	0	
Detained, subject to return	9	
Infested or infected parcels destroyed	3	
Total Parcels Inspected		131

PESTS INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested.
Citrus mealy-bug	Coleus	Ohio	5
Citrus mealy-bug	Coleus	Pennsylvania	1
Lace bug	Rhododendron	Tennessee	1
Nematode root-knot	Begonia	Illinois	1
Nematode root-knot	Chrysanthemum	Ohio	1
Nematode root-knot	*Clematis paniculata*	New York	1
Nematode root-knot	Coleus	Ohio	3
Nematode root-knot	Geranium	New York	1
Nematode root-knot	Rose	Ohio	2
San Jose scale	Peach	Ohio	1
San Jose scale	Pear	Ohio	1
San Jose scale	Plum	Ohio	1

THE PINEAPPLE BLACK WEEVIL

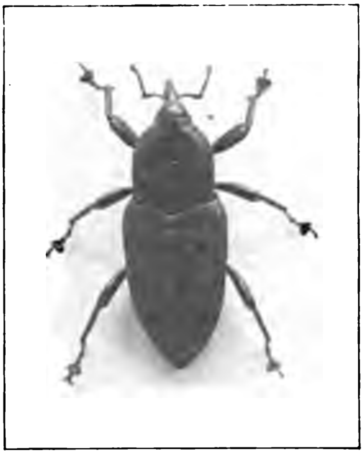

Fig. 73.—The Pineapple Black Weevil, *Metamasius ritchiei* Marshall (from a photograph by Mr. Archibald H. Ritchie).

Through the courtesy of Mr. Archibald Ritchie, Government Entomologist of Jamaica, we are able to present this photograph of the above insect, a description of which was given in The Quarterly Bulletin, Vol. 1, p. 47 (Jan., 1917).

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*..*Editor*

ASSOCIATE EDITORS.

E. W. BERGER..*Entomologist*
F. M. O'BYRNE..*Nursery Inspector*
R. A. JEHLE..*Asst. Plant Pathologist*
FRANK STIRLING..*General Inspector*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

THE ROLL OF HONOR. One realizes that we are at war only when friends or loved ones are called to the colors. Twenty-six of the Plant Board employees have answered the "call" and it is with pride that we print their names on the opening page of this issue. Truly it is a "Roll of Honor", this list of husky young men who have given up home and ambitions to perform the sternest duties of which men are capable and to lay down their lives in the performance if need be. Florida, from a selfish standpoint, can ill afford to spare these men, with their experience in battling with agricultural and horticultural enemies, at a time when many new enemies are knocking at our doors. Yet we spare these men willingly, knowing that they are going to a still greater duty and that they will not be found wanting. The latch string will be out, and the glad hand waiting for them, when they come back.

As far as possible the State Plant Board will hold positions for its employees who are in the military service. At its meeting at Miami on October 8th the Board adopted the following resolution:

"WHEREAS, it is the desire of the State Plant Board of Florida to do everything within its power to facilitate the activities of the military authorities of the country at this time, and

"WHEREAS, many employees of the State Plant Board have voluntarily enlisted in the United States Army and Navy and others have been drafted into said service, and

"WHEREAS, it is the desire of the State Plant Board to provide as far as possible for its employees upon their return from military duty, therefore

"BE IT RESOLVED that, wherever possible, positions made vacant in the State Plant Board work by reason of enlistments or service of the incumbents in the United States Army or Navy be held available for such parties upon their return from military service."

SCALE-INSECTS. No group of insects causes as much loss to fruit growers in the aggregate, as the scale-insects. Small though they are, their ability to increase with great rapidity makes them mighty in their powers of destructiveness. In this issue we present a paper by Mr. C. E. Wilson, until recently Assistant Entomologist of the Plant Board, giving descriptions of 87 species of "scales" found in Florida. Every kind and variety seems to be represented. Here are scales that have come from the tropics, from the extreme North and from the extreme South, from Europe, Asia, Africa and the Islands of the Indian Ocean. What a monument to the indifference with which Florida regarded such dangers until three years ago! From the beginning of American history until the passage of the Florida Plant Act in 1915, our State was a free dumping ground for insect-infested and diseased plants. The farmers, fruit growers and truckers are now paying for all those years of indifference and, strange as it may seem, there are a few who feel that a Plant Board should, in two or three years, control or eradicate all of these introduced pests and thus undo at once all the damage done during more than a half century of neglect!

Fortunately, Florida did not get *all* the pests in the world before she began putting up the bars, but unless the bars are kept up and the protective quarantine made ever stronger and better worse enemies than any we have yet had will be upon us. It appears that the turning point towards victory has been reached in the canker fight and though cases of canker will still be found and many months of tedious inspection are still ahead of us, it is now a certainty that canker *can* be eradicated and that it is *being* eradicated. Let us hope that our experience with canker may never be duplicated by a similar experience with any other menace of like character, but eternal vigilance, effective quarantines, and strict regulations governing the sale and movement of trees and plants are the only things that can grant us immunity from calamities and near-calamities in the future.

Not only must our efforts be directed to keeping out additional enemies of this character, but the campaign must go on relentlessly against those we already have with us. It is but proper, therefore, that we should also present a comprehensive article by Dr. E. W. Berger, Entomologist of the Plant Board, on the practical control of scale-insects. The grower will find in Dr. Berger's article the principles upon which successful control of these insects is based, together with a full discussion of what sprays to use, how to make them and how to apply them.

THE REDLANDS LABORATORY. On October 9th the Plant Board held a well attended public meeting in the League Hall and laboratory in south Dade County. The question as to whether the citrus canker investigations should be continued at the laboratory appeared to be the topic of the hour and was freely discussed. Inasmuch as these investigations have required the maintenance of infected trees in the screened cage connected with the laboratory, many of the growers thought these would be a source of danger in event of a hurricane. The possibility of a storm of sufficient intensity to destroy the cage and scatter its contents must be admitted. Hurricanes in other States have demonstrated their ability to disseminate canker over large areas. The investigations at the laboratory, by Dr. R. A. Jehle, have added much useful information to our knowledge of this disease and there appears no good reason why canker should be longer kept on hand, even in a cage. No "cure" for citrus canker has been discovered but it is now evident that a cure will not be needed for the success of the eradication work is assured. The canker investigations at the Redlands laboratory will, therefore, be discontinued although much of the laboratory equipment will be retained and used, as occasion may arise, for the investigation of other diseases.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II JANUARY, 1918 No. 2

ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
Barcus, Geo. D.	Aviation Section
Bradford, Horace	Federalized Nat'l Guard
Branam, Jas. R.	Navy
Briggs, Wynfred R.	Officers Reserve Corps
Butts, John L.	Aviation Section
Bynum, Eli K.	Field Hospital
Carothers, A. B.	Officers Reserve Corps
Cary, Chas. L.	National Army
Calcote, Wm. H.	Officers Reserve Corps
Chandler, L. L.	Navy
Dickey, Ed. K.	Aviation Section
Dickson, Albert M.	Officers Reserve Corps
Dukes, Redding A.*	National Army
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	National Army
Goldsby, Jack K.	Ambulance Corps
Green, Guilford	1st Lieut. Fed. Nat'l Guard
Grimes, D. W.	Aviation Section
Harn, Sam P.	Naval Reserve Corps
Harrison, Cyrus J.	Aviation Section
Henderson, Francis M.	National Army
Hood, Richard Van	Lieut. Marine Corps
Howell, John F.	Officers Reserve Corps
Little, Floyd L.	Aviation Section
Lovett, J. C.	National Army
McClanahan, Howard S.	Naval Reserve
McCullough, Jas. C.	National Army
Maloney, Clarence B.	Royal Flying Corps
Miller, Herbert L.	Aviation Section
Moore, Jos. W.	Navy
Moore, Jules B.	Engineering Corps
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Quartermaster's Dept.
Robinson, Tom	Navy
Seeds, Harvey W.	National Army

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*Deceased.

Scott, Wm. J.	Hospital Corps
Smith, Clyde	National Army
Smith, Jos. G.	National Army
Smith, L. O.	Officers' Reserve Corps
Steil, Fred H.	Aviation Section
Stephens, Chas. S.	National Army
Swann, Porter R.	Officers' Reserve Corps
Walker, Geo. S.	Aviation Section
Wilson, G. H.	2nd Lieut., Field Artillery

THE AVOCADO WEEVIL
(*Heilipus lauri* Boh.)

AVERY S. HOYT,
Field Deputy, California State Commission of Horticulture.

As in California, the avocado industry of Florida is still in its infancy. As a natural result there is a strong tendency to try out new varieties or at least varieties which are new locally. This brings about a desire upon the part of nurserymen to introduce avocado varieties to meet this demand. The future success of the industry depends to a great extent upon the success of this effort to discover the variety or varieties peculiarly adapted to local conditions. The danger to the industry lies in the fact that the importations thus necessitated may result in the introduction of injurious insects and diseases. It is the fundamental purpose of organizations such as the quarantine service of California and the port and railway inspection service of Florida to assist in this process of importation and propagation by retarding or preventing the introduction of diseases or insects liable to accompany them and which once established might become an ever increasing tax upon the industry. We find evidence of the recognition of this principle as applied to the avocado industry in

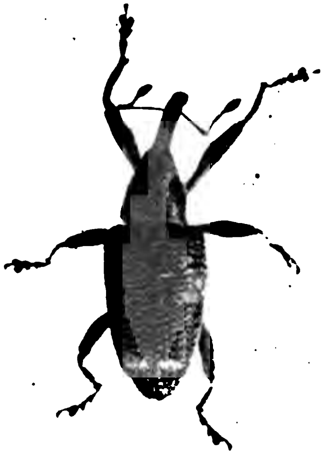

Fig. 74.—The avocado weevil, *Heilipus lauri* Boh. Enlarged 2½ times. (From a photo by Dr. E. W. Berger of specimen furnished by the author.)

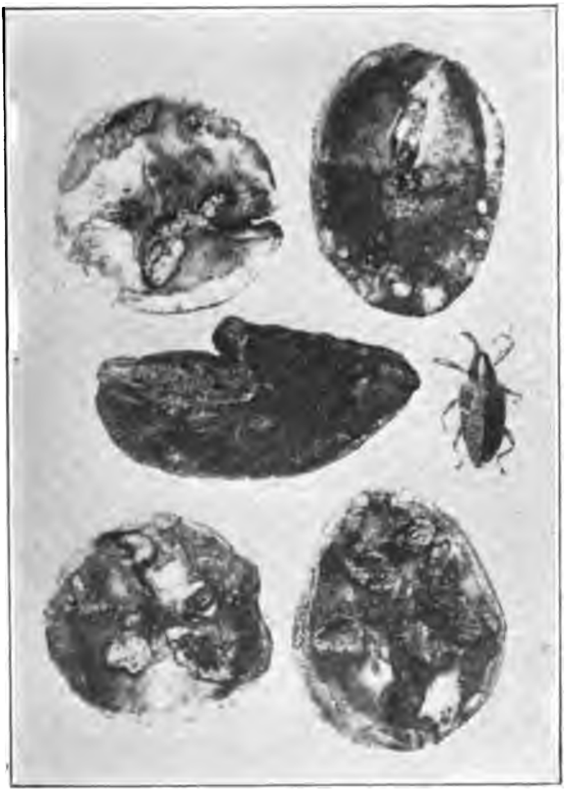

Fig. 75.—Adult avocado weevil and damage by larvae of same to avocado seeds. A single grub may be seen in the burrow in the lower left-hand seed. (Photo by Mr. A. Chubberly, California State Commission of Horticulture.)

the rules and regulations made by the State Plant Board under the Florida Plant Act of 1915, in which the avocado weevil as an enemy of the avocado producer is declared a public nuisance. Since it is that in Florida and in California this weevil is recognized as a possible source of injury to the industry and since both states are following the same general plan of prevention by means of quarantine, it is possible that these brief observations based upon the California quarantine work may prove of interest.

In the years 1912 and 1913 the areas planted to avocados in California began to be greatly increased. A general interest in the growing of this fruit was manifested and consequently the question of an adequate supply of seed for root stock became more and more pressing. It soon developed that those engaged in this business were looking to a variety found in large quantities in Mexico to supply this growing demand. This largely increased demand caused a scouring of the producing areas for seed with the result that seed which had been previously discarded as unfit for shipment was arriving almost daily at the California ports. From the records of the quarantine division we find that at this time there began to appear instances of large quantities of avocado seeds destroyed or refused landing because of the presence of injurious insects. Among these insects recorded at this time appears the avocado weevil, *Heilipus lauri*, Boh., the broad-nosed grain weevil, *Caulophilus latinasus*, Say, the coffee bean weevil, *Araecerus fasciculatus*, De G., and a small rhynchophorid beetle belonging to the family Scolytidae.

There is but little descriptive matter available concerning the appearance and habits of the avocado weevil. Mr. H. S. Barber in the Proceedings of the Entomological Society gives the following description: "Adult weevil of a red ground color, with red femora, or dark brown with unicolorous legs and prominent patches of white scales, rostrum long, prothorax conical. The larvae breed in the seed and their presence is not easily detected." They are large grubs yellowish white in color and reach a half inch in length.

As the quarantine service is not intended to operate as an experimental institution, an exhaustive study of this weevil was not attempted. We were able, however, to establish the fact that in captivity the adult weevils will feed upon fruit, leaves, stems and seeds. A seed which has been allowed to become thoroughly dry and hard was placed in a jar with an adult weevil which had been without food for some time. Fig. 76 shows the marks made upon the dry hard surface of this seed by the powerful beak of the weevil. These observations of course were made upon weevils in captivity and do not necessarily prove the extent of damage which might be caused under field conditions. Mr. Barber, however, reports that an adult weevil was found feeding upon the leaves and stems of young seedlings in one of the experimental greenhouses in Washington.

It was at first believed that the presence of the larva of this weevil in avocado seed could be detected without cutting into the seed, but this assumption did not prove to be correct. We have found two full grown larvae in a single seed which gave no visible indication of the presence of the cavities within. Frequently the presence of these burrows, though not visible, may be determined by a slight pressure upon the seeds which usually betrays at once their hollowed out condition. Sometimes the presence of weevils may be detected by the discolored areas caused by the presence of a burrow close to the surface of the seed. None of these methods, however, is final, as larvae have been found in seeds which passed these tests and from the exterior appeared perfectly sound.

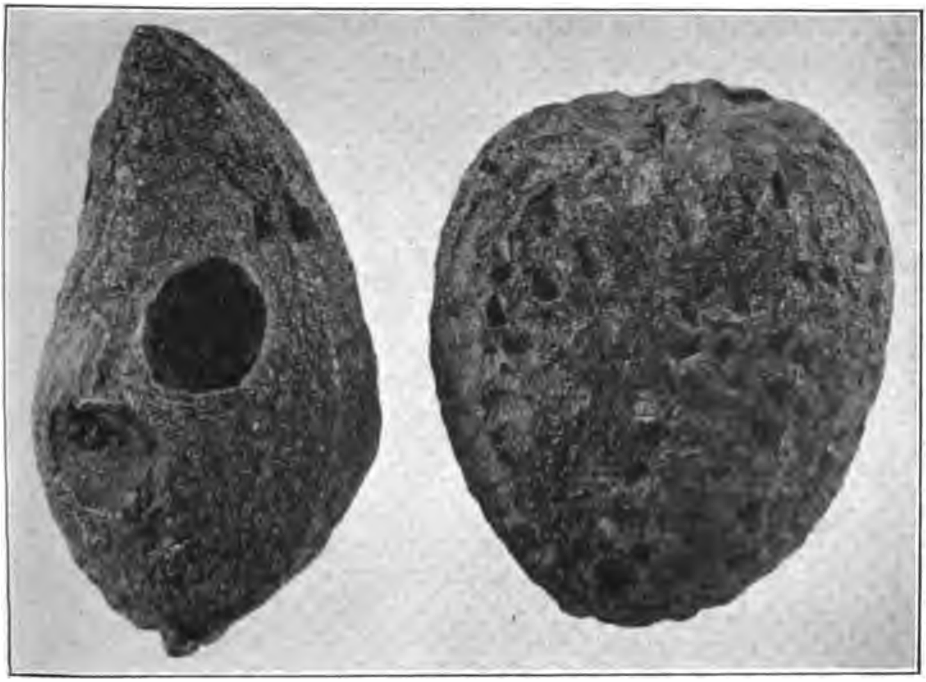

Fig. 76.—Work of avocado weevil on avocado seeds: at left, seed showing hole through which weevil emerged upon reaching maturity; at right, seed showing feeding abrasions made by adult weevil. Enlarged 2⅛ times. (From a photo by Dr. E. W. Berger from specimens furnished by the author.)

This condition makes impractical thorough inspection of avocado seeds for the weevil since it is necessary to open each seed to ascertain whether it is or is not infested. Fumigation was tried in the hope that weevils present, but not detected, might thereby be killed. These experiments were not carried out far enough to permit any definite conclusions, but live larvae and pupae were found in seed which had been treated for six hours in an atmosphere saturated with carbon bisulphide. The Bureaus of Entomology and Plant Industry of the Department of Agriculture cooperating have conducted a series of very important experiments in fumigating seeds. A partial vacuum was used for this purpose with very encouraging results. The work, however, could not at that time be carried on to the desired extent and the vacuum fumigation has not yet been recommended as a means of modifying the avocado seed quarantine.

The Federal Horticultural Board investigated carefully the advisability of importing avocado seeds and came to the conclusion that a quarantine was the only practical remedy in view of existing circumstances. Accordingly on February 27, 1914, Notice of Quarantine No. 12 was issued prohibiting the importation of avocado seeds from Mexico and the countries of Central America. At the same time regulations were issued for the purpose of controlling the importation of avocado fruit and nursery stock from these countries and by these means the danger of the importation of the avocado weevil is rendered very slight. Empowered to enforce the rules and regulations of the Federal Horticultural Board it is now the duty of the port and railway inspectors of Florida and the quarantine officers of California to execute the provisions of these rules and regulations and to do their part in preventing this weevil from securing a hold in this country.

EFFECT OF DISINFECTANTS UPON BACTERIUM CITRI

R. A. Jehle

The bacteria which cause the citrus canker disease may be easily carried from place to place on the surface of anything which comes in contact with them. In order to prevent the distribution of citrus canker as much as possible, it is essential to thoroughly disinfect all things which come in contact with places where any canker organisms may possibly be present before these things are removed to another place. The sanitary precautions used in Florida to prevent the dissemination of citrus canker have been adequately described by the Plant Commissioner.* Disinfectants vary in many respects, and one may be better for some purposes, while another may be better for other purposes. It is very important to know the effect of various strengths of different disinfectants upon *Bacterium citri* Hasse, the organism which causes the citrus canker disease. In the tests made by the writer, the bacteria were introduced into the disinfectant in a moist condition, in droplets of water, and in a dry condition. The organisms were obtained from thoroughly shaken suspensions of *Bacterium citri* in sterilized distilled water, or from pure bouillon or broth cultures. The suspensions were made by macerating infected host tissue with a sterilized glass rod or by pouring sterilized distilled water on agar slants, removing the organisms with a sterilized loop, pouring the liquid into a small sterilized flask, and shaking thoroughly to break up the bacterial masses. In some of the earlier tests the organisms were taken directly from agar slants and introduced into the disinfectant. This method was unsatisfactory, because the time required to kill the organisms depended more upon the rapidity with which the bacterial masses were broken up than upon the strength of the disinfectant. The cultures of *B. citri* which were used in these tests were usually from one to thirty days old, but occasionally older cultures were used. They were grown upon bouillon, potato broth standard agar, potato agar, grapefruit stem and leaf decoction agar, bean agar, and corn-meal agar. Twenty-four different strains of the organism were used besides those obtained from infected host tissue. These strains differed somewhat in their resistance to the various disinfectants. In making up the disinfectants tap water was used in some tests, while distilled water was used in others, and the results were apparantly identical. The tests were conducted at room temperature which averaged about 70 degrees Fahrenheit, seldom falling below 65 degrees F. or rising above 80 degrees F. In the tests with bichloride of mercury, green antiseptic discs (Sharp & Dohm), diamond antiseptic discs (Lily), and C. P. powdered bichloride were used. No difference was observed in the effect of the three different forms upon *B. citri.* The following methods were employed in conducting the tests:

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*Newell, Wilmon—Sanitary Precautions to be Employed in Citrus Properties. Florida Grower, Vol. 14, No. 20, pp. 11-18 (1916).

HILL'S METHOD, MODIFIED (ORGANISMS INTRODUCED INTO DISINFECTANT IN A DRY CONDITION)

This is a modification of the method described by Dr. Hill.* Sterilized glass rods were dipped into bouillon or broth cultures or into a suspension of *B. citri.* Each rod was then placed in a sterilized test-tube plugged with cotton. The tubes containing the rods were kept in the culture room or in an incubator until the rods were dry. Each rod was then immersed in the disinfectant to be treated and removed after an accurately recorded period of time. It was then introduced immediately into a rod of sterilized water. Upon removing the rod from the water it was placed in a tube of sterile bouillon. The bouillon culture was kept in the culture room for a period of one week and observed for growth. If growth occurred in the bouillon culture, a loop of the bouillon was introduced into a tube containing 1 cc. of sterilized water. The loop was shaken well and a loop of the mixture was introduced into a tube of cooled melted agar. When growth appeared in the Petri-dish it was possible by its characteristics or by inoculation to determine whether the growth in the bouillon was caused by *B. citri.*

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*Rept. and papers, Amer. Public Health Assoc., Vol. 24, p. 264, (1898).

GLASS ROD METHOD (ORGANISMS INTRODUCED INTO DISINFECTANT IN LARGE DROPLETS OF WATER)

A glass rod was passed through a bunsen flame, cooled and introduced into a bouillon or broth culture or into a suspension of *B. citri.* The rod was immersed in the disinfectant for an accurately timed period. It was then dipped into a tube of sterilized water, removed and immersed in a tube of cooled melted agar where it was shaken well to remove the organisms. The tube of cooled melted agar containing the bacteria was then poured into a Petri-dish which was kept in the culture room for a period of one week and observed for growth.

PLATINUM LOOP METHOD (ORGANISMS INTRODUCED INTO THE DISINFECTANT IN A LOOP OF LIQUID)

Canker bacteria were removed from a bouillon or broth culture or from a suspension of *B. citri* with a flamed platinum needle. They were introduced into the disinfectant, the loop being continually agitated in the disinfectant for an accurately timed period. A loop of the disinfectant containing the organisms was introduced into a tube containing 1cc. of sterilized water. The loop was well agitated in the water, and a loop of this water was introduced into a sterilized Petri-dish. Cooled melted agar was poured on and the culture was kept in the culture room for a period of one week and observed for growth.

FILTER-PAPER METHOD (ORGANISMS INTRODUCED INTO DISINFECTANT IN A MOIST CONDITION)

Small pieces of filter-paper were wrapped in a paper and sterilized in a hot-air sterilizer. Canker organisms from a bouillon or broth culture or from a suspension of *B. citri* in sterilized water were placed on the filter-paper with a flamed glass rod. The filter-paper absorbed the surplus moisture, leaving the organisms on the surface in a moist condition. The pieces of filter-paper were immersed in the disinfectant to be tested and were kept there for an accurately timed period. They were then removed and washed in sterilized water. From the sterilized water the pieces were removed with a sterilized needle and placed in a sterilized Petri-dish. Cooled melted agar was poured on and the culture was kept in the culture room for a period of one week and observed for growth.

A large number of tests were made with several strengths of each disinfectant. Each strength was tested by all methods, keeping the organisms in the disinfectant for various periods of time. The time required to kill *B. citri* with each strength of the disinfectant was thereby approximately determined. Many more tests were made, keeping the organisms in the disinfectant for the period thus determined. If growth of *B. citri* occurred in any of the tests the time was increased by five to fifteen seconds and the tests were repeated until a maximum time was found in which all of the organisms were killed in at least five tests. In comparing the results by each method for each strength of the disinfectant, it was found that they were governed by certain general rules. When the results of any tests varied greatly from these general rules, further tests were made in order to detect any possible error. In every case check tests were made using sterile water in place of the disinfectant. All tests were rejected in which there was no growth of *B. citri* in the check plates. The number of colonies of *B. citri* in the check plates was usually large, frequently almost covering the entire surface of the plate. (Plates 1 and 2.) In the following table the disinfectants are given in the order of their ability to kill *B. citri*.

DISINFECTANT	STRENGTH	METHOD	MAXIMUM TIME REQUIRED TO KILL *B. citri*.
Bichloride	1-500	Filter-paper	5 seconds
Bichloride	1-500	Platinum loop	10 seconds
Bichloride	1-500	Glass rod	10 seconds
Bichloride	1-500	Hill	10 seconds
Bichloride	1-1000	Filter-paper	5 seconds
Bichloride	1-1000	Platinum loop	30 seconds
Bichloride	1-1000	Glass rod	40 seconds
Bichloride	1-1000	Hill	30 seconds
Bichloride	1-1500	Filter-paper	5 seconds
Bichloride	1-1500	Platinum loop	40 seconds
Bichloride	1-1500	Glass rod	40 seconds
Bichloride	1-1500	Hill	30 seconds
Bichloride	1-2000	Filter-paper	5 seconds
Bichloride	1-2000	Platinum loop	40 seconds
Bichloride	1-2000	Glass rod	2¼ minutes
Bichloride	1-2000	Hill	30 seconds
Bichloride	1-2500	Filter-paper	10 seconds
Bichloride	1-2500	Platinum loop	50 seconds
Bichloride	1-2500	Glass rod	4¼ minutes
Bichloride	1-2500	Hill	50 seconds
Bichloride	1-3000	Filter-paper	20 seconds

DISINFECTANT	STRENGTH	METHOD	MAXIMUM TIME REQUIRED TO KILL *B. citri.*
Bichloride	1-3000	Platinum loop	1¼ minutes
Bichloride	1-3000	Glass rod	6¼ minutes
Bichloride	1-3000	Hill	1¼ minutes
Chlorazene	1-250	Filter-paper	5 seconds
Chlorazene	1-250	Platinum loop	20 seconds
Chlorazene	1-250	Glass rod	20 seconds
Chlorazene	1-250	Hill	30 seconds
Chlorazene	1-500	Filter-paper	10 seconds
Chlorazene	1-500	Platinum loop	50 seconds
Chlorazene	1-500	Glass rod	50 seconds
Chlorazene	1-500	Hill	1¼ minutes
Chlorazene	1-1000	Filter-paper	30 seconds
Chlorazene	1-1000	Platinum loop	1¼ minutes
Chlorazene	1-1000	Glass rod	1¼ minutes
Chlorazene	1-1000	Hill	2½ minutes
Chlorazene	1-1500	Filter-paper	40 seconds
Chlorazene	1-1500	Platinum loop	1½ minutes
Chlorazene	1-1500	Glass rod	1¼ minutes
Chlorazene	1-1500	Hill	2½ minutes
Chlorazene	1-2000	Filter-paper	1 minute
Chlorazene	1-2000	Platinum loop	2 minutes
Chlorazene	1-2000	Glass rod	2 minutes
Chlorazene	1-2000	Hill	2¾ minutes
Trikresol	½% solution	Filter-paper	30 seconds
Trikresol	½% solution	Platinum loop	30 seconds
Trikresol	½% solution	Glass rod	40 seconds
Trikresol	½% solution	Hill	1½ minutes
Trikresol	1% solution	Filter-paper	10 seconds
Trikresol	1% solution	Platinum loop	10 seconds
Trikresol	1% solution	Glass rod	10 seconds
Trikresol	1% solution	Hill	50 seconds
Trikresol	2% solution	Filter-paper	5 seconds
Trikresol	2% solution	Platinum loop	10 seconds
Trikresol	2% solution	Glass rod	10 seconds
Trikresol	2% solution	Hill	40 seconds
Trikresol	3% solution	Filter-paper	5 seconds
Trikresol	3% solution	Platinum loop	10 seconds
Trikresol	3% solution	Glass rod	10 seconds
Trikresol	3% solution	Hill	10 seconds
Lysol	½% solution	Filter-paper	1 minute
Lysol	½% solution	Platinum loop	1 minute
Lysol	½% solution	Glass rod	1¼ minutes
Lysol	½% solution	Hill	1¾ minutes
Lysol	1% solution	Filter-paper	20 seconds
Lysol	1% solution	Platinum loop	20 seconds
Lysol	1% solution	Glass rod	30 seconds
Lysol	1% solution	Hill	1 minute
Lysol	2% solution	Filter-paper	5 seconds
Lysol	2% solution	Platinum loop	10 seconds
Lysol	2% solution	Glass rod	10 seconds
Lysol	2% solution	Hill	50 seconds
Lysol	3% solution	Filter-paper	5 seconds
Lysol	3% solution	Platinum loop	10 seconds
Lysol	3% solution	Glass rod	10 seconds
Lysol	3% solution	Hill	30 seconds
Creolin-Pearson	1-50	Filter-paper	20 seconds
Creolin-Pearson	1-50	Platinum loop	10 seconds
Creolin-Pearson	1-50	Glass rod	10 seconds
Creolin-Pearson	1-50	Hill	30 seconds

DISINFECTANT	STRENGTH	METHOD	MAXIMUM TIME REQUIRED TO KILL *B. citri.*
Creolin-Pearson	1-75	Filter-paper	50 seconds
Creolin-Pearson	1-75	Platinum loop	20 seconds
Creolin-Pearson	1-75	Glass rod	50 seconds
Creolin-Pearson	1-75	Hill	50 seconds
Creolin-Pearson	1-100	Filter-paper	50 seconds
Creolin-Pearson	1-100	Platinum loop	30 seconds
Creolin-Pearson	1-100	Glass rod	1 minute
Creolin-Pearson	1-100	Hill	1 minute
Carbolic acid	1% solution	Filter-paper	40 seconds
Carbolic acid	1% solution	Platinum loop	1½ minutes
Carbolic acid	1% solution	Glass rod	1⅓ minutes
Carbolic acid	1% solution	Hill	2¾ minutes
Carbolic acid	2% solution	Filter-paper	20 seconds
Carbolic acid	2% solution	Platinum loop	20 seconds
Carbolic acid	2% solution	Glass rod	30 seconds
Carbolic acid	2% solution	Hill	1¼ minutes
Carbolic acid	3% solution	Filter-paper	5 seconds
Carbolic acid	3% solution	Platinum loop	20 seconds
Carbolic acid	3% solution	Glass rod	20 seconds
Carbolic acid	3% solution	Hill	40 seconds
Carbolic acid	4% solution	Filter-paper	5 seconds
Carbolic acid	4% solution	Platinum loop	10 seconds
Carbolic acid	4% solution	Glass rod	10 seconds
Carbolic acid	4% solution	Hill	30 seconds
Carbolic acid	5% solution	Filter-paper	5 seconds
Carbolic acid	5% solution	Platinum loop	10 seconds
Carbolic acid	5% solution	Glass rod	10 seconds
Carbolic acid	5% solution	Hill	20 seconds
Formaldehyde	.8% solution (2% commercial)	Filter-paper	1 minute
Formaldehyde	.8% solution (2% commercial)	Platinum loop	1¾ minutes
Formaldehyde	.8% solution (2% commercial)	Glass rod	1¼ minutes
Formaldehyde	.8% solution (2% commercial)	Hill	4⅓ minutes
Formaldehyde	1.2% solution (3% commercial)	Filter-paper	20 seconds
Formaldehyde	1.2% solution (3% commercial)	Platinum loop	1½ minutes
Formaldehyde	1.2% solution (3% commercial)	Glass rod	1¼ minutes
Formaldehyde	1.2% solution (3% commercial)	Hill	3 minutes
Formaldehyde	1.6% solution (4% commercial)	Filter-paper	10 seconds
Formaldehyde	1.6% solution (4% commercial)	Platinum loop	1⅓ minutes
Formaldehyde	1.6% solution (4% commercial)	Glass rod	1¼ minutes
Formaldehyde	1.6% solution (4% commercial)	Hill	2¼ minutes
Formaldehyde	2% solution (5% commercial)	Filter-paper	10 seconds
Formaldehyde	2% solution (5% commercial)	Platinum loop	1½ minutes
Formaldehyde	2% solution (5% commercial)	Glass rod	1¼ minutes

DISINFECTANT	STRENGTH	METHOD	MAXIMUM TIME REQUIRED TO KILL *B. citri.*
Formaldehyde	2% solution (5% commercial)	Hill	1¾ minutes
Formaldehyde	2.4% solution (6% commercial)	Filter-paper	10 seconds
Formaldehyde	2.4% solution (6% commercial)	Platinum loop	1 minute
Formaldehyde	2.4% solution (6% commercial)	Glass rod	1 minute
Formaldehyde	2.4% solution (6% commercial)	Hill	1¾ minutes
Formaldehyde	2.8% solution (7% commercial)	Filter-paper	10 seconds
Formaldehyde	2.8% solution (7% commercial)	Platinum loop	40 seconds
Formaldehyde	2.8% solution (7% commercial)	Glass rod	40 seconds
Formaldehyde	2.8% solution (7% commercial)	Hill	1½ minutes
Formaldehyde	3.2% solution (8% commercial)	Filter-paper	10 seconds
Formaldehyde	3.2% solution (8% commercial)	Platinum loop	20 seconds
Formaldehyde	3.2% solution (8% commercial)	Glass rod	20 seconds
Formaldehyde	3.2% solution (8% commercial)	Hill	50 seconds
Kreso	1-25	Filter-paper	5 seconds
Kreso	1-25	Platinum loop	10 seconds
Kreso	1-25	Glass rod	10 seconds
Kreso	1-25	Hill	20 seconds
Kreso	1-40	Filter-paper	5 seconds
Kreso	1-40	Platinum loop	10 seconds
Kreso	1-40	Glass rod	10 seconds
Kreso	1-40	Hill	1 minute
Kreso	1-50	Filter-paper	10 seconds
Kreso	1-50	Platinum loop	10 seconds
Kreso	1-50	Glass rod	10 seconds
Kreso	1-50	Hill	1½ minutes
Kreso	1-75	Filter-paper	20 seconds
Kreso	1-75	Platinum loop	20 seconds
Kreso	1-75	Glass rod	20 seconds
Kreso	1-75	Hill	2¼ minutes
Kreso	1-100	Filter-paper	30 seconds
Kreso	1-100	Platinum loop	30 seconds
Kreso	1-100	Glass rod	1 minute
Kreso	1-100	Hill	2½ minutes
Zenolium	1-25	Filter-paper	5 seconds
Zenolium	1-25	Platinum loop	10 seconds
Zenolium	1-25	Glass rod	10 seconds
Zenolium	1-25	Hill	20 seconds
Zenolium	1-40	Filter-paper	5 seconds
Zenolium	1-40	Platinum loop	10 seconds
Zenolium	1-40	Glass rod	10 seconds
Zenolium	1-40	Hill	1¼ minutes
Zenolium	1-50	Filter-paper	20 seconds
Zenolium	1-50	Platinum loop	20 seconds
Zenolium	1-50	Glass rod	20 seconds
Zenolium	1-50	Hill	1½ minutes
Zenolium	1-75	Filter-paper	30 seconds

DISINFECTANT	STRENGTH	METHOD	MAXIMUM TIME REQUIRED TO KILL *B. citri.*
Zenolium	1-75	Platinum loop	30 seconds
Zenolium	1-75	Glass rod	30 seconds
Zenolium	1-75	Hill	2¼ minutes
Zenolium	1-100	Filter-paper	1¼ minutes
Zenolium	1-100	Platinum loop	1 minute
Zenolium	1-100	Glass rod	2¼ minutes
Zenolium	1-100	Hill	2½ minutes
Maldezone	Full strength	Filter-paper	5 seconds
Maldezone	Full strength	Platinum loop	10 seconds
Maldezone	Full strength	Glass rod	10 seconds
Maldezone	Full strength	Hill	20 seconds
Maldezone	1-5	Filter-paper	5 seconds
Maldezone	1-5	Platinum loop	40 seconds
Maldezone	1-5	Glass rod	40 seconds
Maldezone	1-5	Hill	1 minute
Maldezone	1-10	Filter-paper	10 seconds
Maldezone	1-10	Platinum loop	1½ minutes
Maldezone	1-10	Glass rod	1¾ minutes
Maldezone	1-10	Hill	1¾ minutes
Maldezone	1-25	Filter-paper	1 minute
Maldezone	1-25	Platinum loop	2¼ minutes
Maldezone	1-25	Glass rod	2¼ minutes
Maldezone	1-25	Hill	3½ minutes
Avenarious carbolinium	Full strength	Filter-paper	5 seconds
Avenarious carbolinium	Full strength	Platinum loop	10 seconds
Avenarious carbolinium	Full strength	Glass rod	50 seconds
Avenarious carbolinium	Full strength	Hill	10 seconds
Copper-sulphate	2% solution	Filter-paper	20 seconds
Copper-sulphate	2% solution	Platinum loop	1¼ minutes
Copper-sulphate	2% solution	Glass rod	1½ minutes
Copper-sulphate	2% solution	Hill	4¼ minutes
Copper-sulphate	3% solution	Filter-paper	20 seconds
Copper-sulphate	3% solution	Platinum loop	1 minute
Copper-sulphate	3% solution	Glass rod	1¾ minutes
Copper-sulphate	3% solution	Hill	3¾ minutes
Copper-sulphate	4% solution	Filter-paper	20 seconds
Copper-sulphate	4% solution	Platinum loop	50 seconds
Copper-sulphate	4% solution	Glass rod	50 seconds
Copper-sulphate	4% solution	Hill	2¾ minutes
Copper-sulphate	5% solution	Filter-paper	10 seconds
Copper-sulphate	5% solution	Platinum loop	40 seconds
Copper-sulphate	5% solution	Glass rod	50 seconds
Copper-sulphate	5% solution	Hill	3½ minutes
Copper-sulphate	6% solution	Filter-paper	10 seconds
Copper-sulphate	6% solution	Platinum loop	10 seconds
Copper-sulphate	6% solution	Glass rod	10 seconds
Copper-sulphate	6% solution	Hill	2½ minutes
Copper-sulphate	7% solution	Filter-paper	10 seconds
Copper-sulphate	7% solution	Platinum loop	10 seconds
Copper-sulphate	7% solution	Glass rod	10 seconds
Copper-sulphate	7% solution	Hill	2¼ minutes
Copper-sulphate	8% solution	Filter-paper	5 seconds
Copper-sulphate	8% solution	Platinum loop	10 seconds
Copper-sulphate	8% solution	Glass rod	10 seconds
Copper-sulphate	8% solution	Hill	1½ minutes

By examining the above table it may be seen that *B. citri* is frequently killed in the same period of time by the filter-paper,

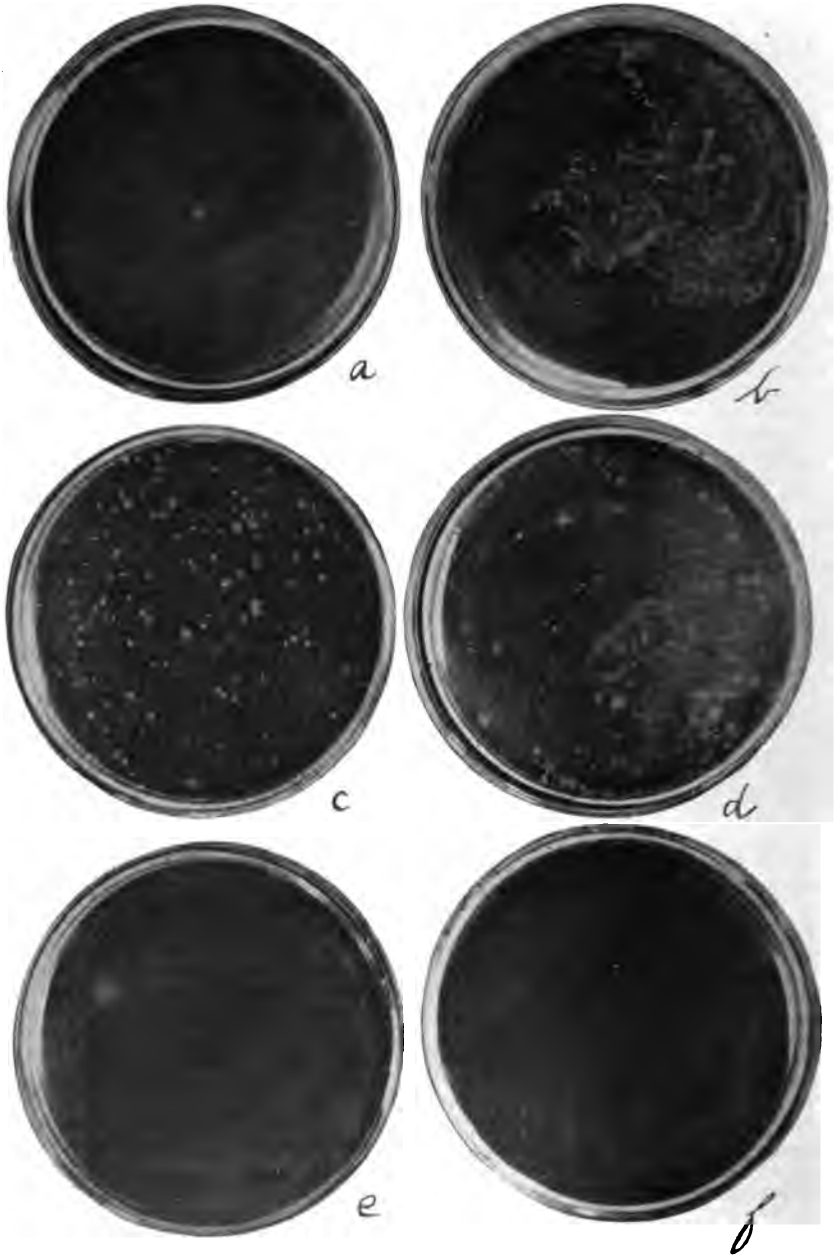

Plate I.—Effect of trikresol and formaldehyde on *B. citri*: *a*, check, glass rod method; *b*, check, platinum loop method; *c*, *B. citri*, kept in a 2.8% formaldehyde solution (7% commercial) for 30 seconds, glass rod method; *d*, *B. citri* kept in a ¼% solution of trikresol 1½ minutes, platinum loop method; *e*, *B. citri* kept in a 2.8% formaldehyde solution (7% commercial) for 40 seconds, glass rod method; *f*, *B. citri* kept in a 3.2% formaldehyde solution (8% commercial) for 20 seconds, platinum loop method. (Original.)

loop, and rod methods, but that when there is any difference, they are killed most quickly by the filter-paper method, and the longest time is required by the glass rod method. In the filter-paper method the organisms are introduced into the disinfectant in a moist condition with only a small film of liquid surrounding them. In the platinum loop method they are introduced into the disinfectant in a very similar condition, since they are very quickly mixed with the disinfectant by the agitation of the loop. In cases where the organisms are killed more quickly by the filter-paper method, it may be due to the fact that the disinfectant is not all washed out of the filter-paper. In the glass rod method the organisms are introduced into the disinfectant in rather large droplets of water clinging to the rod. Since it requires some time for the disinfectant to penetrate the droplet of water, the time required to kill *B. citri* by this method depends upon the rapidity with which the disinfectant penetrates the droplet of water, as well as upon the strength of the disinfectant. This is especially noticeable in the weaker strengths of the bichloride solutions. In the Hill method the organisms are introduced into the disinfectant in a dry condition and in this condition, the organisms are naturally more resistant to the disinfectants and a longer time is required to kill them.

Some differences have been observed in the resistance of different strains of *B. citri* to disinfectants, and one strain used in the above tests was particularly resistant.

Several investigators have found that the addition of foreign matter to disinfectants decreases their efficiency and that a reduction in temperature of the disinfectant has a similar effect.* A certain amount of foreign matter was undoubtedly introduced into the disinfectants by the methods employed by the writer. The addition of 10% red soil to a 1-1500 solution of bichloride did not increase the time required to kill *B. citri* by the Hill method.

The effect of two 1-1500 solutions of bichloride kept at different temperatures was tested upon *B. citri*. One solution was kept at a temperature of 80 degrees F. and the other was kept at a temperature of 44 degrees F. The time required to kill *B. citri* in the solution kept at 80 degrees was 30 seconds, while the time required to kill the organism in the solution kept at 44 degrees F. was 40 seconds. Thus a reduction in the temperature of bichloride solutions increases the time required to kill *B. citri*.

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*Smith, E. F.—Bacteria in relation to plant diseases, Vol. II, pp. 192-196 (1911).

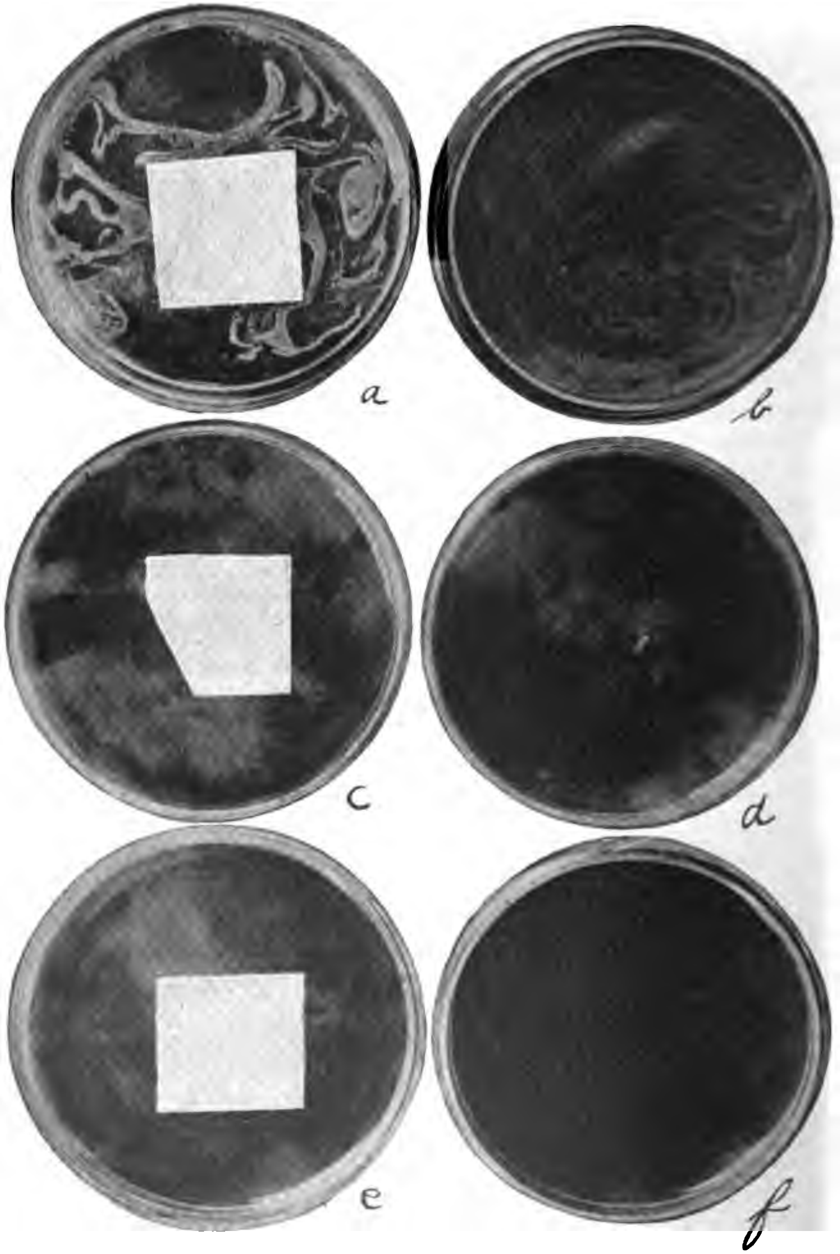

Plate II.—Effect of zenolium, bichloride, carbolic acid and creolin on *B. citri*: *a*, check, filter-paper method; *b*, check, glass rod method; *c*, *B. citri* kept in 2% solution of carbolic acid for 20 seconds, filter-paper method; *d*, *B. citri* kept in a 1-100 solution of zenolium 2¼ minutes, glass rod method; *e*, *B. citri* kept in a 1-100 solution of Creolin-Pearson 50 seconds, filter-paper method; *f*, *B. citri* kept in a 1-200 solution of bichloride of mercury 2¼ minutes, glass rod method. (Original.)

In order to make allowances for these variations it is always well to make up disinfectants somewhat stronger than is indicated in the above table. When the weather is cold, or when foreign matter is likely to be added to the disinfectant with objects immersed in it it is well to increase the strength of the disinfectant.

It has been found that objects which are removed from a solution usually dry off in a period of one minute. For objects which are merely dipped into a disinfectant, a strength should be selected which will kill *B. citri* in a period of at least one minute by all of the tests outlined above. The following disinfectants have been found to kill *B. citri* in a period of at least one minute by all of the methods used: Bichloride of Mercury 1-1500, Chlorazene 1-250, Trikresol 1% solution, Lysol 1% solution, Creolin-Pearson 1% solution, Carbolic Acid 3% solution, Formaldehyde 8% commercial (3.2%), Kreso 1-40, Zenolium 1-25, Maldezone 1-5, and Avenarious Carbolinium, full strength.

CITRUS BLAST

ROBERT W. HODGSON,
University of California.

Citrus blast is a comparatively new disease of a bacterial nature affecting citrus trees, particularly the orange, and is endemic to the citrus sections of northern and central California. This disease was first observed by the writer near Palermo, Butte County, in 1912, but did not assume economic importance until 1915. At that time, following a late wet spring which provided climatic conditions favorable for its activity, it spread rapidly and became a problem of a somewhat serious nature in Butte County citrus districts. Attention was called to it and the name "citrus blast" proposed by Professor J. Eliot Coit of this station in 1916.* Since the season of 1915 citrus blast has continued to spread and has now been reported from practically all parts of the citrus producing districts of northern and central California, although as yet it has not been found in southern California. In view of the fact that in 1915 it was confined to only two local areas its spread must be considered very rapid.

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*Coit, J. E. Citrus Blast—a New Disease in California. Univ. Calif. Jour. Agr. 1916; V. 3, No. 6.

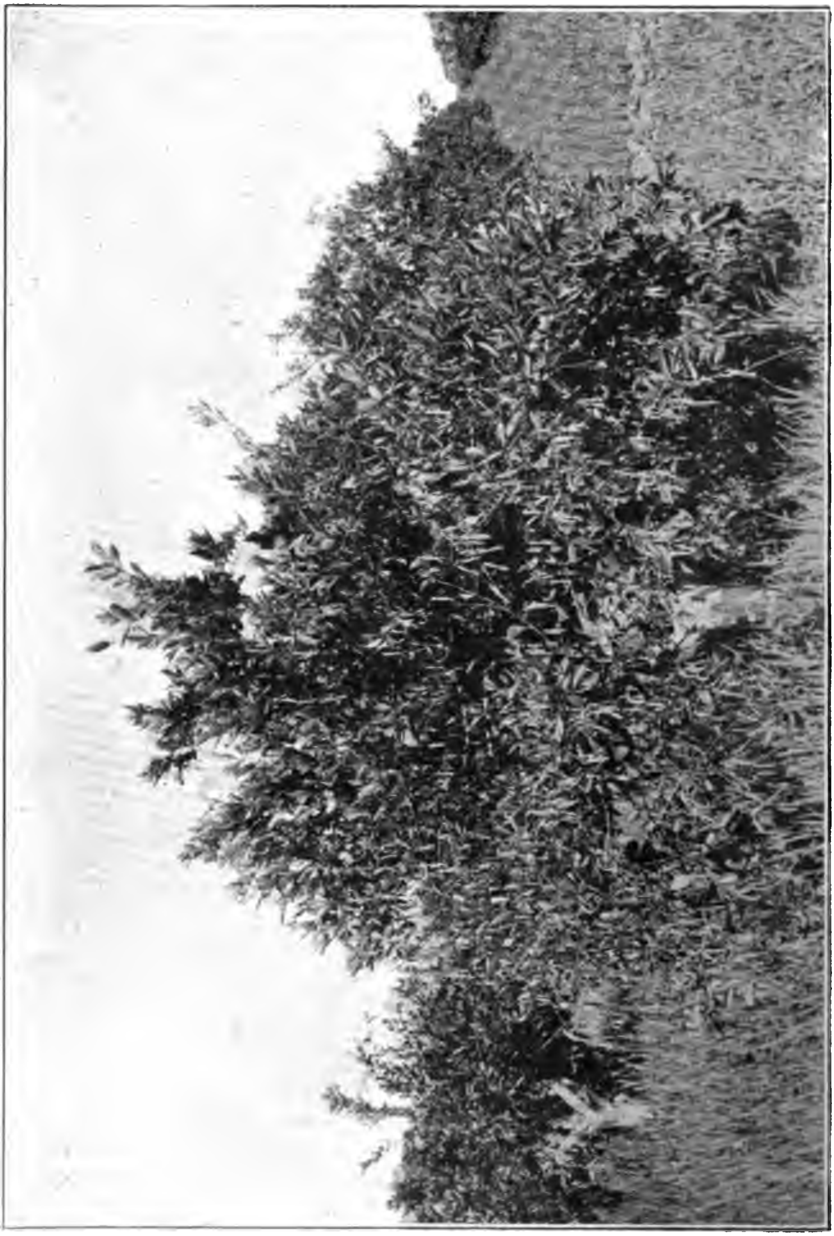

Plate III.—Early summer stage in citrus blast injury. Note the bared twigs and shriveled leaves. Citrus blast resembles pear blight very much in its effects. (Courtesy Div. of Plant Pathology, Univ. of Cal. College of Agr.)

As knowledge of its characteristics is as yet very meager among citrus growers it is entirely possible that this disease has a much wider distribution than is now suspected. This last season was quite favorable to its activity and citrus blast manifested itself in a more virulent form than ever. The writer made a trip early in last April thru the Oroville-Palermo citrus area and found the disease everywhere and in a much more virulent form than he had ever observed it before. Other members of the College of Agriculture have reported it as particularly widespread and severe during the last season.

DISEASE CHARACTERS

Citrus blast is often mistaken by the uninitiated for frost injury, which it resembles to a certain degree. The early spring stage bears a marked resemblance to pear blight (see Plate III). This similarity is as real as apparent when the life history of the disease and its mode of infection are known.

Infection is apparently confined to new spring growth or unseasoned wood produced the last season, and occurs mainly at the junction of the petiole and blade of the leaf. Apparently a certain amount of infection also occurs at the tips of the very young leaves and tender shoots. Upon infection, the leaf turns pale yellow, then darkens irregularly in spots and wilts in place, where it later shrivels and dries, still hanging to the shoot. Once established, the disease progresses rapidly down the shoot toward the older wood. Only relatively new growth is affected, the older limbs possessing greater resistance. The young shoots are often killed back to the older wood, including a portion of the bark about the base of the shoot. At these points characteristic lesions are formed. (See Plate IV.) It is not unusual to find a branch several feet long with every node affected in this manner. If the disease is virulent and conditions favorable, as was the case last season, it may attack branches of the previous season's growth as large as a half inch in diameter, killing them back for a distance of several feet. The killed area about the base of the infected leaf or shoot varies considerably in size and is ordinarily more or less irregular in shape, frequently extending some distance along the stem. (See Plate IV.) In the case of younger growth, girdling may occur about the point of infection with the resultant death of the shoot to this point. The rapidity with which the disease spreads is remarkable and only a few days of the proper weather conditions are required for serious damage.

With the approach of summer, activity is retarded by the low humidity and in midsummer the disease is apparently quiescent.

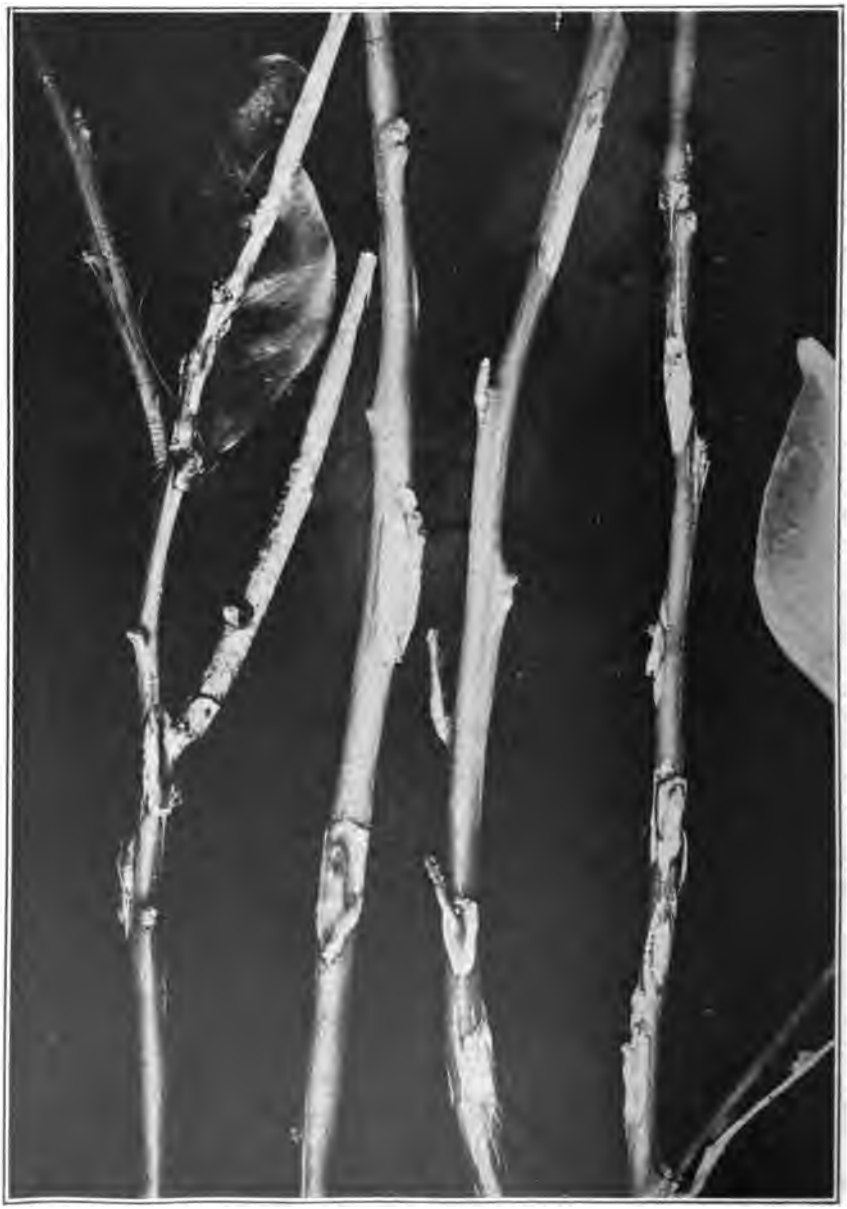

Plate IV.—Citrus blast. The characteristic lesions or cankers produced at the base of infected leaves. (Courtesy Div. of Plant Pathology, Univ. of Cal. College of Agr.)

The wilted leaves and killed shoots shrivel and dry and become infected with sundry saprophytic fungi among which are common withertip, Cladosporium, and Botrytis. The line of separation between healthy and dead tissue becomes very clear-cut and definite. In early summer the lesions often exude a pinkish resinous gum or bacterial slime. Such lesions and all the dead tissues later take on a characteristic dark red color. The dead twigs when dry are very hard and tough. During the healing process wound callus is developed at the infected nodes, which raises the dead lesions up in the form of scab-like masses. These are sloughed off in the course of time, leaving very characteristic scars which are visible for several years. Later in the season the effects of the disease are masked by the new growth and to find it at this time one must examine those branches with a diameter of less than three-quarters of an inch for the presence of the cankers.

CAUSAL ORGANISM

Even before citrus blast had been carefully studied all indications pointed to a bacterial causal organism. Its remarkable rapid activity and spread from infected orchards to those on the windward side alone, together with its marked resemblance to pear blight and complete absence of any external indications of a fungus nature early pointed to a bacterial cause. It remained for H. A. Lee, formerly connected with the Division of Plant Pathology of this station, to isolate the causal organism which proved to be a new bacterium.* This bacterium he called *Bacterium citrarefaciens* from its withering effect on citrus leaves. (See Fig. 77.) It does not invade the vascular tissues but concentrates in the parenchymatous tissues, destroying the cell structure. He succeeded in isolating the organism from lesions which had been dried for four months, which is very significant in establishing the fact that the disease may exist over the summer in the dead lesions.

DAMAGE DONE BY CITRUS BLAST

Citrus fruit is produced on wood of the current season's growth. This puts out in early spring, bearing the fruit buds which open in April. As has been stated above, under favorable moisture and temperature conditions this tender new growth may be very seriously attacked by citrus blast. Depending on

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*Lee, H. A. A New Bacterial Citrus Disease. Jour. Agr. Res. Vol. 9, No. 1, Apr, 2, 1917.

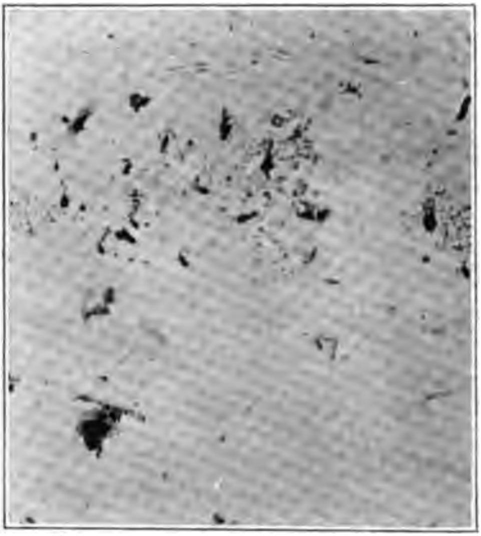

Fig. 77.—Citrus blast, *Bacterium citrarefaciens*, greatly magnified. Note the polar flagella. (Courtesy Div. of Plant Pathology, Univ. of Cal. College of Agr.)

the stage of growth, the character of the damage varies. Attacks early in the season may kill all this fruiting brush back to the old wood, but if weather conditions change it may be killed back only part way.

In the event that the first named condition occurs, new fruiting brush must be grown, and this draws on the reserve food and strength of the tree. Blooming is delayed several weeks and the normal processes of nutrition in the tree so weakened and disturbed that the proportion of fruit "setting" may be reduced. If the new wood is only killed back part way, a resprouting of the uninjured portion occurs which, while not delaying blooming so long, may have the same general effect as the damage in the previous case. In addition, this resprouting may result in an abnormal clustering of the flowers, which is not desirable.

It very frequently happens in northern citrus districts that the trees are in bloom when conditions occur which are favorable to the disease. Sometimes the flowers are attacked and killed, in which case no compensatory growth occurs. The main damage, therefore, consists of a reduction of the leaf area and the loss of a portion of the fruit-bearing wood.

MOISTURE AND TEMPERATURE RELATIONS

Citrus blast is not active except when a certain optimum combination of moisture and temperature conditions occurs. Such a combination is possible in California only during late winter and spring or occasionally for short intervals in the fall after the rainy season has begun. Activity is inhibited by dry air, which is the rule in California except during and immediately after rainy spells. Apparently the bacterium is not active at relatively low temperatures. During the ordinary winter season no citrus blast activity can be seen but with the advent of spring when the average daily temperature rises and the weather is damp and warm activity begins. In years when the rainy season is late this period of possible activity is prolonged and the damage is much more severe than usual. Seasons of this sort occurred in 1915 and 1917. Moreover, in the northern citrus sections where the rainfall is normally somewhat greater than further south, it frequently happens that a warm damp spell will coincide with the early spring flush of growth. Such conditions are ideal for the rapid spread of citrus blast. The disease leaves its quiescent state and spreads with great rapidity thru the orchards. A few days of this sort of weather are sufficient to cause serious damage. With the coming of the dry season activity is stopped and the disease becomes quiescent.

From the moisture and temperature relations discussed above it can readily be appreciated that in a more tropical climate where the atmospheric humidity is high citrus blast might prove a very serious disease. Indeed, under California conditions its activity is restricted to a period so short that we cannot even hazard an opinion as to its possible damage were it under tropical conditions.

CONTROL MEASURES

Very little in the nature of measures for control or eradication has been tried up to the present time. Some growers have practiced pear blight control methods but without any marked success. So far as is known, absolutely nothing in the way of prevention by spraying has been tried. This apathy on the part of growers as to preventive measures is due to the relative newness of the disease and the lack of knowledge concerning its characteristics, as well as the fact that it is only in late seasons that it causes serious losses. Since it is bacterial in nature, we may expect that efficient control will be difficult. Undoubtedly the bacterium lasts over the dry summer in the cankers or lesions and becomes active again when climatic conditions are favorable. Therefore careful pruning out and burning of all infected growth would seem to be the most practical means of eradication. This practice will probably prove more difficult and expensive with citrus trees than with pears or apples, because of their evergreen nature which makes it much more difficult to find the lesions. Further, citrus trees have a quite different habit of growth and much more fine brush which will considerably enhance this difficulty. Altogether we may say, that as yet we have no method which promises satisfactory control.

It is to be hoped that in the near future comprehensive investigations on the manner of distribution, methods of control or eradication, and other important questions will be undertaken.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING DECEMBER 31, 1917.

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending December 31st, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING DECEMBER 31, 1917.

Citrus grove trees inspected	3,361,398
Citrus nursery trees inspected	10,394,720
Inspectors employed	286
New properties showing infection	0
Total properties showing active infection	3
Grove trees found infected	4
Nursery trees found infected	0
Counties in which active infections were found	1

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,708
Nursery trees found infected since May, 1914	342,254
Number properties infected to December 31, 1917 (This number includes nine (9) properties which have shown re-infection. When parts of infected properties have been sold the portion disposed of, when infected, is carried as another infected property under the name of the new owner.)	477
Properties declared no longer "danger centers"	415
Properties still classed as "infected" December 31, 1917	62

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to December 31, 1917:

1914		1915		1916		1917	
		Jan.	306	Jan.	86	Jan.	14
		Feb.	165	Feb.	21	Feb.	4
		Mar.	444	Mar.	49	Mar.	9
		Apr.	408	Apr.	49	Apr.	169
May	108	May	1042	May	338	May	52
June	160	June	772	June	450	June	45
July	275	July	651	July	349	July	39
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30
Sept.	767	Sept.	618	Sept.	124	Sept.	6
Oct.	565	Oct.	214	Oct.	451	Oct.	2
Nov.	773	Nov.	494	Nov.	131	Nov.	1
Dec.	366	Dec.	256	Dec.	27	Dec.	1

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING DECEMBER 31, 1917

The following report on the inspection of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector:

SHIPS AND VESSELS INSPECTED:			
From foreign ports	456		
From U. S. ports other than Florida	179		
From Florida ports	368		
Total		1003	
SHIPMENTS INSPECTED:			
Arriving by water:			
Passed	85		
Treated and passed	2		
Returned to shipper	33		
Detained, subject to return by shipper	2		
Contraband destroyed	191		
		313	
Arriving by land—Express, Freight, Wagons, Etc.:			
Passed	401		
Treated and passed	18		
Returned to shipper	267		
Detained, subject to return by shipper	287		
Contraband destroyed	46		
		1019	
Total shipments inspected			1332

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of shipments infested
Aphis sp.	Chrysanthemum	Cuba	1
Aphis sp.	Hibiscus	Cuba	1
Aphis sp.	Rose	New York	1
Aspidiotus britannicus	Cocoa palm	Florida	1
Aspidistra scale	*Anthurium* sp.	Illinois	1
Aspidistra scale	Unknown plant	Illinois	1
Black scale	Gardenia	Pennsylvania	1
Black scale	*Hoffmannia* sp.	Illinois	1
Black scale	Poinsettia	Cuba	1
Boisduval's scale	*Billbergia* sp.	Illinois	1
Boisduval's scale	*Karatas princeps*	Illinois	1
Boisduval's scale	Palm	New York	1
Boisduval's scale	Unknown plant	Illinois	1
Coccus sp.	*Miconia magnifica*	Illinois	1
Crown gall	Alva bush	No. Carolina	1
Crown gall	Apple	Georgia	1
Crown gall	Plum	Ohio	1
Crown gall	Rose	New York	1
Crown gall	*Rubus* sp.	Iowa	1
Cyanophyllum scale	*Miconia magnifica*	Illinois	1
Cyanophyllum scale	Palm	Connecticut	1
Cyanophyllum scale	Palm	New York	1
Dictyospermum scale	*Acanthorhiza aculeata*	Illinois	1
Dictyospermum scale	*Anthurium* sp.	Illinois	1
Dictyospermum scale	*Billbergia* sp.	Illinois	1
Dictyospermum scale	Palm	New York	2
Dictyospermum scale	Unknown plant	Illinois	1
Florida red scale	Cocoa palm	Florida	1
Florida red scale	*Ficus* sp.	Florida	1
Florida red scale	*Ficus* sp.	Illinois	1
Florida red scale	Palm	Connecticut	1
Florida red scale	Palm	New Jersey	1
Greedy scale	Rose	Florida	1
Green shield-scale	*Anthurium* sp.	Illinois	1
Hairy root	Euonymus	Alabama	1
Long scale	Citrus	Florida	1
Mealy-bug	*Miconia magnifica*	Illinois	1
Mealy-bug	*Metrosideros floribunda*	Pennsylvania	1
Mealy-bug	Palm	Connecticut	1
Mulberry whitefly	Holly	No. Carolina	1
Nematode root-knot	Fig	Alabama	1
Nematode root-knot	Fig	Florida	1
Nematode root-knot	Fig	Georgia	1
Nematode root-knot	Fig	No. Carolina	1
Nematode root-knot	Fig	So. Carolina	1
Nematode root-knot	Grape	Florida	1
Nematode root-knot	Mulberry	Iowa	1
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Rose	New York	1
Orthezia insignis	Chrysanthemum	Cuba	1
Peach borer	Peach	Georgia	1
Perforated palm scale	Palm	Connecticut	1
Pineapple scale	Dracena	Illinois	1
Pineapple scale	*Billbergia* sp.	Illinois	1

Insect or Disease	Occurring on	From	Number of shipments infested
Purple scale	Citrus	Florida	1
Putnam's scale	*Acer* sp.	Ohio	1
Putnam's scale	Apple	Ohio	1
Rose scale	Raspberry	Iowa	1
Rose scale	Rose	New York	1
San Jose scale	Apple	Georgia	1
San Jose scale	Cherry	Georgia	1
San Jose scale	Peach	Florida	1
San Jose scale	Peach	Georgia	1
San Jose scale	Peach	Michigan	1
San Jose scale	Pear	Georgia	1
San Jose scale	Pecan	Florida	1
San Jose scale	Plum	Florida	1
San Jose scale	Plum	Georgia	1
San Jose scale	Plum	Kentucky	1
San Jose scale	Plum	Pennsylvania	2
San Jose scale	Unknown plant	No. Carolina	1
Snow scale	Citrus	Florida	1
Soft scale	*Ficus* sp.	Illinois	1
Soft scale	*Pinanga* sp. (Palm)	Illinois	1
Tree-hoppers	Camphor	Florida	1
Walnut scale	Cherry	Indiana	1
Walnut scale	Peach	Florida	1
Whitefly	Citrus	Florida	1
Whitefly	Privet	Alabama	1
Woolly apple aphis	Apple	Georgia	1

PARCEL POST PLANT INSPECTION

QUARTER ENDING DECEMBER 31, 1917

PARCELS INSPECTED:

Passed	904	
Treated and passed	18	
Returned to sender	2	
Detained, subject to return by sender	1	
Infested or infected parcels destroyed	1	
Total Parcels Inspected		926

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of parcels infested
Bruchus sp.	Cow peas	Florida	1
Dictyospermum scale	Palm	New Jersey	1
Florida red scale	Palm	New Jersey	1
Nematode root-knot	Unknown plant	Kentucky	1
Rose scale	Raspberry	Iowa	1

Redding A. Dukes

It is with feelings of the keenest regret and of personal loss, not unmixed with pride, that the news of the death of Redding A. Dukes has been received by the members of the staff of the State Plant Board: regret that one who had been associated with us in our work should have been gleaned by the grim reaper, personal loss in that we who were his co-workers would hereafter carry on our work without the thought that he would again sometime be working by our side, pride that one of our number had given his life in the service of our country and in the defense of world democracy. The death of Mr. Dukes occurred at Camp Jackson, S. C., on Jan. 3rd, 1918, as the result of cerebro spinal meningitis. At the time of his death Mr. Dukes was attached to the 13th Co., 4th Training Battalion, 156th Depot Brigade. His untimely death deprives the country of the services of a promising

Redding A. Dukes

young man, for as evidence of the high esteem in which he was held and the regard which his superior officers had for his abilities Mr. Dukes had been assigned for duty at the Officers Training Camp with orders to report Jan. 5th.

Redding A. Dukes was born at Worthington Springs, Fla., on Nov. 14, 1887, and was educated in the public schools and at the University of Florida, from which latter institution he was graduated in the class of 1916. While at the University he specialized in Agriculture and Horticulture and this training specially fitted him for the duties he was called upon to perform when he became an attache of the State Plant Board and an Agent of the Bureau of Plant Industry, U. S. D. A. Almost immediately after his graduation Mr. Dukes was appointed an Agent of the Bureau and an Inspector of the Board, after having passed with honor an examination as to his qualifications and thereafter served faithfully in the various positions to which he was assigned in the co-operative work being done by these two forces in the eradication of citrus canker. In this work he was of great help and his experience, studious habits and training made him a valuable man in the service. In November of 1917 he cheerfully and willingly answered the call of his country and humanity and entered the U. S. Army, being one of the many men of our force who responded to the call.

The death of Redding A. Dukes means to us the loss of a friend and co-worker. It also means that forevermore his name will be held in our memories as the first of our number to have sacrificed his life on the altar of liberty.

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*..*Editor*

ASSOCIATE EDITORS.

E. W. BERGER..*Entomologist*
F. M. O'BYRNE..*Nursery Inspector*
FRANK STIRLING..*General Inspector*
J. H. MONTGOMERY..*General Grove Supervisor*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900.

ERADICATE THE BOLL WEEVIL? The present is a period characterized by huge undertakings, so much so in fact that we have come to accept as a matter of course the raising of huge armies, the organization of stupendous business enterprises and the accomplishment of engineering feats heretofore considered impossible.

This spirit of progress, this willingness to undertake the apparently impossible, is also found in the fields of economic entomology and applied plant pathology. No longer is the scientist satisfied with sprayings or other measures which bring about a fairly "satisfactory" control of an injurious insect or plant disease. He seeks for means whereby the arch enemies of agriculture may be annihilated; if not from the earth, at least from considerable areas on its surface. Eradication—which is but another name for complete annihilation—is the goal now aimed at by entomologists and plant pathologists in applying their respective sciences for the benefit of agriculture.

A new principle in the warfare against pests and diseases is now being recognized, namely, that it is more economical to eradicate an injurious insect or disease, even at a cost of several million dollars, than to keep up a running warfare with it for all time to come, the aggregate cost of the latter and the losses sustained being many times greater than the cost of eradication.

Attempts to apply this principle are not hard to find. In Florida, for example, over $900,000 has thus far been expended in the eradication of citrus canker and the success of the undertaking seems now assured even though the total cost may reach one and a quarter or even one and a half million dollars. The result of this undertaking will be the salvation of an industry representing an investment of a quarter billion dollars and yielding an annual return of ten or more millions.

Near Houston, Texas, the Federal Horticultural Board, in cooperation with the Texas authorities, is now engaged in eradicating the pink bollworm. Approximately one thousand men are engaged in this undertaking and the weekly expenditure is in the neighborhood of $15,000. The area in which cotton fields are infested covers five million acres. The success of this eradication campaign will mean that the South's staple crop, cotton, will be saved from the ravages of an insect which is at least the equal of the boll weevil in destructiveness.

The investigations and experience of the past twenty years have shown conclusively that the boll weevil has no food plant other than cotton, that it can in fact subsist only upon the parts of the living plant. Not even cotton seed or cotton seed meal will serve the beast as an emergency ration. Of the countless thousands of boll weevils kept under observation by entomologists not one has ever lived a full twelve months. If, therefore, the growth of cotton were completely prevented throughout the entire infested area of the country—and this area is nearly coextensive with the cotton growing area east of the Rocky Mountains—for a period of not less than twelve months, the pest would be exterminated. No boll weevil could live through such a period of enforced starvation to start infestation in the crop of the season following. The suggestion is not a new one by any means: it has been put forth annually since the weevil first invaded south Texas from Mexico, but has not apparently been regarded seriously by the agricultural authorities mainly, no doubt, on account of the number and nature of the practical difficulties in the way of applying the method. It has been argued that all the farmers could not be induced to dispense with cotton growing for one season and that, even were no cotton crop planted, volunteer cotton along roadways, around farm buildings and in waste places would serve as breeding places for the weevil and thus tide it over the "no-cotton" year. It has also been suggested that for the Southern States to go out of cotton for one year would result in little less than an upheaval and demoralization of the industries dependent mainly or entirely on cotton and its byproducts.

That one hundred per cent cooperation on the part of the farmers, in refraining from cotton culture for one year, could not be secured goes without saying. Abstinence from cotton culture during the year in question would have to be made compulsory and would require suitable legislation by Congress and by all of the states affected. Objections would be made to such legislation, but by the time our war with Germany is over we will have become accustomed to federal regulation of our industries, activities and even personal habits to a degree heretofore undreamed of. The farmers will by that time have a far different attitude towards federal or state regulation than they have had in the past. To prevent cotton culture in all the Southern States would, except as to the area involved, be in no essential respect different from what is now actually being undertaken by government and state in several south Texas counties. So far as the area is concerned, it is not materially greater than that formerly infested by the cattle tick and it is everywhere conceded that eradication of the latter will soon be complete.

Volunteer cotton could be located and destroyed by competent inspectors; in short almost every acre of land in the South would have to be thoroughly patrolled for this purpose. Finding cotton plants is a far easier task than, for example, detecting minute canker spots on orange and grapefruit leaves in groves containing thousands of large trees. Technically trained inspectors would not be necessary: every farmer in the South is already a qualified inspector, provided only that he is a man of sterling worth, conscientious and reliable. Practically every county in the cotton area already has its demonstration agent and each state has its corps of skilled entomologists and quarantine officials. Thus is the skeleton work for the necessary organization already at hand.

Such an attempt would perhaps be unwise until after the war and, in any event, several—perhaps three to five—years preparation should be made for the "no-cotton" year, during which period the necessary legislation would be enacted and the organization perfected for the task itself. With from three to five years' advance notice as to the year in which no cotton would be grown, it would seem that both farmer and manufacturer could make adjustments which would largely or entirely obviate the consequences which would follow a failure of the cotton crop for a single season. Farmers could, for example, greatly increase their cotton acreage during the season or seasons preceding the no-cotton year. The no-cotton year would afford opportunity for the production of large amounts of feedstuffs and forage so that an unusually large cotton acreage could be planted in the year immediately following the no-cotton year. With the boll weevil disposed of, it seems reasonable to suppose that at least as much cotton could be produced in two seasons as is now produced in three. Thus for the three-year period—one year without cotton and two without boll weevils—the cotton production of the South would be practically the same as if the growing of cotton for the one season were not dispensed with. Once the weevil is eradicated there is no reason why it should ever again become established. We know more now about keeping pests out than we did thirty-six years ago, when the weevil marched boldly across the Mexican border—and kept on marching.

There is no feature of such an eradication plan which is impossible of accomplishment. The only question is, are we as Americans willing to tackle a really big thing in the entomological field and "put it across?"

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II APRIL, 1918 No. 3

THE PINK BOLLWORM PROBLEM IN THE UNITED STATES

W. D. HUNTER
Federal Horticultural Board, U. S. Department of Agriculture.

INTRODUCTION IN MEXICO

In 1910 a Greek, who had been engaged in cotton planting in Egypt, arrived at Washington to urge the importation of Egyptian cotton seed and the establishment of the production of Egyptian cotton in the United States. For various reasons this man was not employed by the Department of Agriculture. He proceeded to Mexico in a short time, and located at Monterey

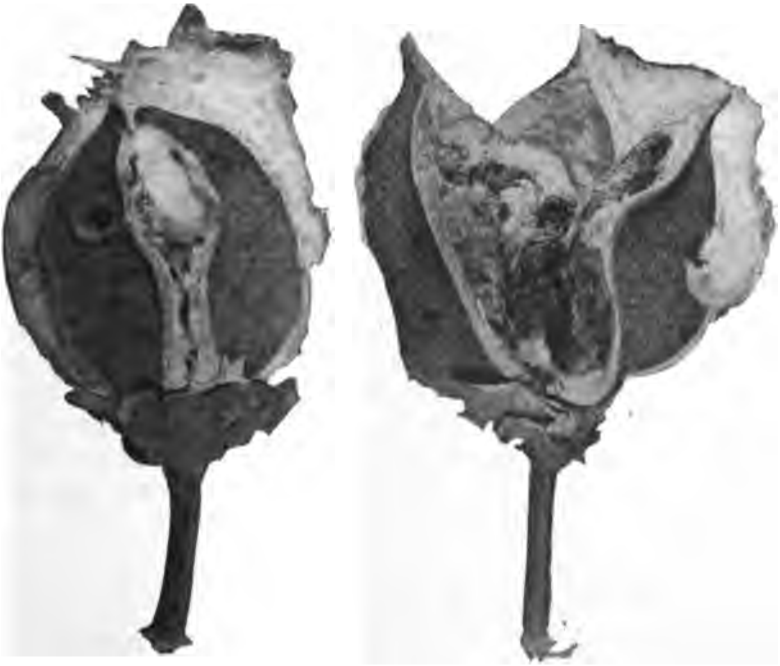

Fig. 78.—Difference between injury by common bollworm and by pink bollworm: left boll shows injury by the ordinary bollworm *(Heliothis obsoleta)*—note the large orifice with raised edges; right boll shows injury by the pink bollworm—note the comparatively small clean-cut orifices in carpel. The difference is so great that the work of the two insects can easily be differentiated, even if only a portion of a carpel of a boll is found. (Original.)

where he interested a company owning large tracts of land in the planting of Egyptian cotton in that country. In 1911 this company imported one hundred and twenty-five sacks of Egyptian cotton seed which was planted in the immediate vicinity of Monterey. This seed was not disinfected and must have been infested by the pink bollworm. Naturally the infestation did not develop to any great extent with the first crop, which was large and attracted considerable attention. As a consequence much of the seed produced was shipped for planting to the Laguna region where the bulk of the Mexican cotton is produced. In this way the pink bollworm was spread in a very short time throughout a large territory in Mexico. It has been found that practically all of the plantations in the Laguna are now infested. Some of them showed a falling off in the crop of 1917 of from fifty to seventy-five per cent.

Two other infestations in Mexico are known to have resulted from seed shipped for planting purposes from the Laguna. One of these localities is near Allende, about forty miles south of Eagle Pass. The other is immediately opposite Del Rio, Texas, where about two hundred and fifty bushels of Laguna seed were planted in 1917.

The determination that the pink bollworm occurs in Mexico was made early in November, 1916, as the result of the sending of specimens of what was recognized as a new pest from a plantation in the Laguna via Mexico City to Washington. As soon as this information was at hand the Federal Horticultural Board stopped the further importations of seed, and began energetic steps to remove the danger of the infestation of the Texas fields as the result of the arrival of the seed which had been shipped in during the several preceding months.

INTRODUCTION IN THE UNITED STATES

In 1916, for various economic reasons, large quantities of Mexican seed were shipped to the United States. The total amounted to more than five hundred carloads. This seed was shipped to eleven mills in Texas for crushing.

The first step taken by the Federal Horticultural Board was to trace the various carloads of seed to their destinations and as far as possible to expedite crushing. Customs house records made it possible to locate all of the seed without difficulty. The mill owners were called together; the danger was explained and co-operation was immediately forthcoming in all of the suggestions made by the Department. As soon as seed could be crushed special means were taken to have all of the mill premises cleaned; that is, the chutes, conveyors and roadways were freed of cotton seed.

In 1917 a number of special men were employed to scout the fields growing in the vicinities of the mills which had received Mexican seed. This work was continued actively throughout the season. In September one slight infestation was found in the immediate vicinity of the mill at Hearne, and during the following month a similar infestation was found at Beaumont, where one hundred and fourteen carloads of seed had been received.

At both Hearne and Beaumont immediate steps were taken to destroy the infested fields and to safeguard in various ways the cotton and cotton products originating in the localities. The plants were uprooted or chopped down and burned with the aid of oil. The fields were then carefully gone over and all vestiges of cotton removed. Over seven thousand acres were treated in this way at an average cost of $10.72 per acre. The cotton products were exported as far as possible and the seed crushed under supervision.

Shortly after the discovery of the pink bollworm in Jefferson County the presence of the insect was determined at Anahuac on Galveston Bay. It was first thought that this infestation was

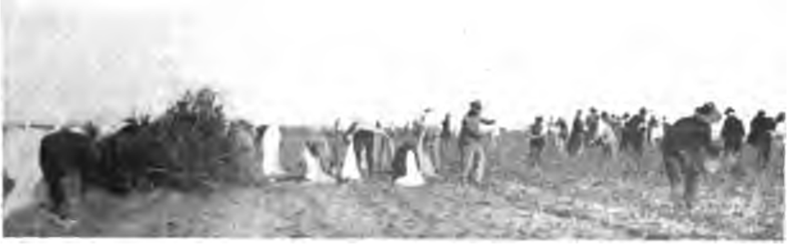

Fig. 79.—Laborers engaged, under direction of the Federal Horticultural Board, in destroying all cotton plants, bolls, locks and seeds in the area in southern Texas which was found infested by the pink bollworm in the latter part of 1917. (Photo by Ed. L. Ayers, Texas State Dept. of Agr.)

due to the carriage of Mexican seed from Beaumont about sixty miles away. Most careful investigations, however, failed to reveal any proof that the Galveston Bay infestation was attributable to the Beaumont seed. As the investigations proceeded further infestation was found around Trinity Bay, extending as far as Galveston County.

The only explanation of the infestation around Galveston Bay which is at all satisfactory is that it was due to the washing ashore of a considerable number of bales of Mexican cotton in the great storm of August, 1915. Several thousand bales of this cotton have been traced to Galveston where they were on the docks at the time of the storm. Altogether more than twenty thousand bales of cotton, in which a portion of the Mexican bales were included, were washed ashore. They were salvaged at various points around Trinity Bay from Smith's Point on the East to Texas City on the West. In many cases the force of the water had broken the bands and the cotton with the contained seeds was scattered over a wide territory. A fact which tends to corroborate the theory of the establishment of the pink bollworm through the wreckage of the Mexican cotton is that the infestation has been found to be heavier near the water line and to become gradually less towards the interior. While it has not been possible to prove beyond all doubt that the foregoing is the true explanation of the origin of the Galveston Bay infestation, it is by far the most satisfactory theory which has been propounded. Mr. Busck, who is our leading authority on the pink bollworm, and who has studied it in Mexico, especially in relation to the degrees of infestation resulting from introduction at different dates, is convinced that it is not necessary to go back of 1915 to explain the situation around Trinity Bay, and that the natural spread of the insect and its carriage in seed for planting purposes from farm to farm would explain fully the extent of the infestation which has been found to exist.

PLAN OF WORK AGAINST THE PINK BOLLWORM

The work which the Department of Agriculture has under way to remove the menace of the pink bollworm may be classified in five groups as follows:

1. Exclusion from the United States of cotton seed from all foreign countries.
2. The fumigation of all bales of foreign cotton, arriving

at the United States, in vacuum chambers under Federal supervision.

3. The regulation of the traffic from Mexico, which includes the interior fumigation and the exterior spraying of all cars.

4. The eradication of the insect in Texas in co-operation with the State Department of Agriculture under a special law provided by the Legislature. This includes the operation of three cotton-free zones of considerable size.

5. Work in Mexico looking towards the eradication of the insect in that country to eliminate the possibility of further infestation of the United States from that source.

The importance of excluding all foreign cotton seed from the United States is evident and means have been provided by the Federal Horticultural Board in co-operation with the Customs Service to enforce the embargo. The only existing danger in this connection is in mail shipments, and efforts are being made to increase the extent of control over such shipments.

The United States normally receives about two hundred thousand bales of foreign cotton annually. This is all admitted under permits issued by the Federal Horticultural Board at specified ports including only Boston, New York and San Francisco. As a condition of entry the bales are all fumigated with hydrocyanic acid gas in vacuum chambers. This is the outcome of a long series of experiments performed at Washington and elsewhere in which it was determined that the system was effective and practicable.

The protection secured at the Mexican Border Ports is under strict rules and regulations, including the disinfection of freight, cars, baggage and express. The necessary men are located at all of the ports and the work now consists of excluding all cars which show traces of cotton seed as well as the fumigation of all commodities related to cotton, or which might by any possibility have been subjected to contamination. As there is a possibility that the pink bollworm moth might be brought in on the outside of cars, or on the running gear, the spraying of all cars which would possibly come in contact with the insect in Mexico is required.

A preceding paragraph has dealt with the work of the eradication of the insect in Texas, but an additional word should be given about the cotton-free zones. One of these is at Hearne, where the original infestation was found. It consists of a circular area with a radius of two and one-half miles about the

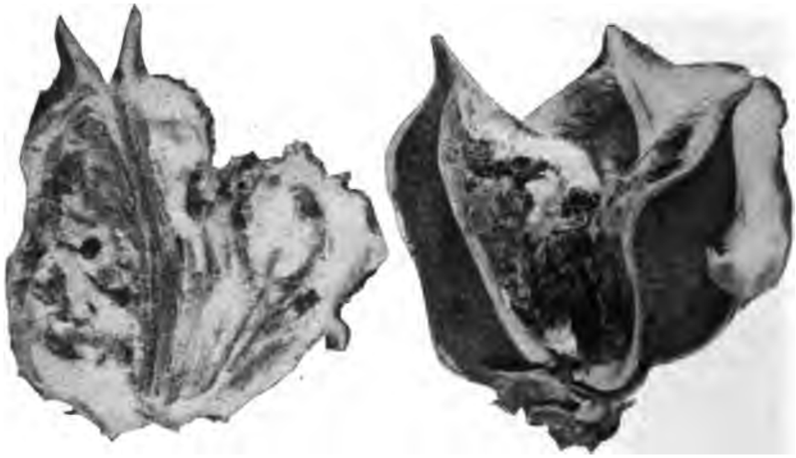

Fig. 80.—Cotton bolls showing injury by the pink bollworm, *Pectinophora gossypiella* Saunders. (Original.)

only fields which were found infested after very careful investigation. The second non-cotton area is in Southeastern Texas, and extends from Jefferson County on the East to include a portion of Fort Bend County on the West. This is by far the largest and most important of the cotton-free zones provided. The third consists of three counties on the Rio Grande opposite the infestation found in Northern Mexico.

There has naturally been some opposition to the establishment of cotton-free zones in Texas, especially in the Southeastern district, where the cultivation of cotton has been increased greatly within the last few years. The State officials, however, have been fully alive to the importance of the situation and the necessity of taking the most drastic steps provided for by law. The opposition has been local. The great majority of the farmers in the district have been quite in sympathy with the work. At the present writing it is evident that local opposition is diminishing, and there is every indication that a satisfactory, absolute cotton-free zone will be provided.

It is proposed to prohibit the planting of cotton in these zones for a period of three years.

The work in Mexico, which is under the direction of Mr. August Busck, consists of educational features looking toward co-operation with the planters and the Government in the eradication of the pest in the Laguna. Sufficient damage has been done in the Laguna to convince the planters that they must do something to protect their interests. The lands are controlled by comparatively few persons. The situation is isolated, and there is considerable probability that a voluntary cotton-free area will be established throughout the Laguna. Similar possibilities exist in the case of the two other infestations in Mexico to which reference has been made.

In connection with the general work in Mexico Mr. Busck has two technical assistants making a complete study of the life history and bionomics of the pink bollworm. The investigational work which has been done heretofore, while good in its way, was not under conditions closely approaching those of the United States. The Egyptian and Hawaiian observations need to be repeated and multiplied so that we will have the fullest possible information regarding the habits of the insect under such conditions as exist on this continent.

NATURE AND AMOUNT OF DAMAGE

The pink bollworm affects cotton production in several ways. It destroys a certain number of bolls or portions of bolls in which case the lint produced is short and kinky. In some cases as much as 75 per cent of the crop is lost in this way. The injury however, does not end with the reduction of yield of lint. The crop of seed is correspondingly reduced and what is obtained is of light weight and poor grade. In the crushing of Egyptian seed in England it was found that the oil content was lower than normal by about 20 per cent, that the oil actually secured was of dark color, and comparatively low value. The work of the insect is also of importance in connection with seed for planting. The percentage of germination is naturally low and much larger quantities must be planted to secure a stand.

The most accurate information concerning the damage by the pink bollworm is in a recent paper by L. H. Gough. The investigator conducted studies in lower and middle Egypt to determine the number of bolls attacked by the pink bollworm. The samples consisted each of 100 green bolls taken at random in fields in various localities. These samples were sent to Cairo where they were given a very careful examination. The total number of bolls examined in this work was 106,400 and the examinations continued from July to November. The following are the results of this investigation:

Percentage infested during July less than 10.
Percentage infested during August from 10 to 25.
Percentage infested during September from 25 to 75.

Percentage infested during October from 75 to 89.

These figures show in a very striking manner the great damage of which the pink bollworm is capable. They may be taken as a fair indication of the injury which would be done in the United States as the seasonal conditions here are similar to those in Egypt. In short, they show approximately 25 per cent of the August bolls and 50 per cent of the September bolls would be destroyed or rendered practically valueless by the insect. Of course the bolls not attacked would develop but the loss would undoubtedly amount to at least as much as 50 per cent of the crop which would develop if the insect were not present.

In the Hawaiian Islands the pink bollworm has prevented the development of the cotton industry which at one time showed considerable promise.

DESCRIPTION AND LIFE HISTORY OF THE PINK BOLLWORM

The moth resembles somewhat the common clothes moth of this country. From tip to tip of the extended wings it measures from 3-5 to 4-5 of an inch. It is of a dark brown color, the fore-wings ending in a rather sharp point. The eggs are very small objects, somewhat oval, about 1 mm. long and 5-10 mm. broad. The surface is white and finely wrinkled. The larva when first hatched is glassy white with light brown anterior markings. It grows rapidly and when mature measures nearly a half inch in length. It is cylindrical, white, with the dorsal side strongly colored with pink.

The pupa is about 2-5 of an inch in length, reddish brown in color, the posterior end pointed and ending in a hook-like process.

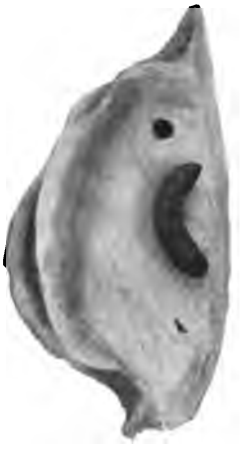

Fig. 81. — Pink bollworm on divided wall in cotton boll, showing opening it makes in going from one lock to the next. (Original.)

There are several insects found in the bolls of cotton in the United States which may be mistaken for the pink bollworm. One of these is the so called pink corn worm which frequently is found in decaying bolls, especially those which have been injured by disease. It has not been known to attack healthy bolls. It does not normally make its way into the seed and this habit will help in distinguishing it from the pink bollworm. Another insect which may be mistaken for the pink bollworm is the common bollworm of cotton, *Heliothis obsoleta.* This is the same insect as feeds on corn and is known in some parts of the country as the corn ear worm. It bores holes through the carpels of the bolls, feeds for a short time, and then proceeds to another boll. In the early stages it sometimes assumes a somewhat pinkish color. It may be distinguished from the pink bollworm by its habits, especially by the fact that it does not feed altogether in the interior of the bolls and that it is not found within the seeds. When full grown it is much larger than the pink bollworm, measuring about 2 inches in length when it is fully developed.

Although these descriptions may help in enabling any one to determine whether the pink bollworm is present in a cotton field, it will always be best to send any specimens to an entomologist without delay for authoritative determination. It is extremely important that any possible infestation by this insect be brought to attention at the earliest possible date that prompt eradicative measures be taken.

The eggs are laid singly or in small groups on the green bolls or in the flowers. Generally the eggs are to be found near the points of the green bolls in the sutures marking the locks. As many as four eggs may be found in this situation and altogether as many as twenty eggs have been found on a single boll. It is estimated that a female will deposit in the neighborhood of 100 eggs. These hatch in from four to twelve days.

The larva immediately on hatching bores its way into the boll. The infested bolls sometimes become recognizable by a reddish or blackened discoloration which follows attack. But Mr. Busck finds that the only conclusive evidence of infestation is the finding of the eggshell at the entrance hole or the larva itself within the boll.

The food of the larvae is the seed within the boll. It devours one and generally proceeds to the next above. Ordinarily a single larva does not make its way outside of the lock which it first invades but occasionally the adjoining lock may be entered. It is to be noted that the larva restricts itself to the interior of the boll and never makes its way to the outside for the purpose of reaching another boll. When the larva reaches full growth it often protects itself by webbing two seeds together the attachment being made to openings brought into contact by the insect.

These "double seeds" are characteristics of the work of the insect. They are generally not destroyed with the process of ginning and furnish the best means of determining quickly whether any lot of seed is infested.

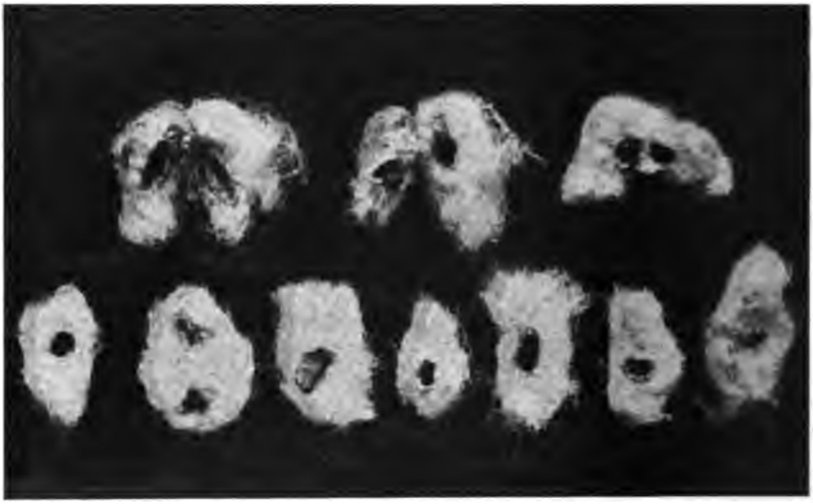

Fig. 82.—Cotton seeds infested by the pink bollworm: above, so-called "twin seeds", being two seeds drawn together by the larva in its last stage. (Original.)

During the summer the larval stage occupies from twenty to thirty days. Later in the season this stage may be more or less indefinitely prolonged. Gough found in Egypt that larvae would remain in a quiescent condition for over two years.

After a variable time, as has been indicated, the larva transforms into a pupa or chrysalis. This stage lasts from ten to twenty days, when the moth emerges. The duration of life of the moth is rather short. Under favorable conditions, Mr. Busck succeeded in keeping some specimens alive for thirty-two days but under the same conditions the great majority of the insects died in fourteen to twenty days.

The moth is very seldom seen in nature. Its habit is to hide during the day under stones or brush. The normal time of flight is from 6:30 to 8 p. m. Although apparently capable of prolonged flight, they prefer to go no further than the first cotton field.

As far as known the pink bollworm has no food plants other than cotton. Statements in the literature on the subject that the species feeds on various other plants are probably due to mistaken identification. Among these statements are ones to the effect that the insect has been found on hibiscus in India and pomegranate in Egypt, and on milo in Hawaii. In any case the latter record is erroneous as Mr. Busck was unable to find the insect on milo or induce it to feed on that plant after numerous and persistent efforts. In the Hawaiian Islands there is a wild hibiscus of somewhat common occurrence. It is attacked by a relative of the pink bollworm but this insect is not found upon it, either in natural conditions or when confined in cages.

As far as observed, the insect has no preference for cultivated varieties of cotton. The perennial or Caravonica, Chinese, Sea Island, and American Upland varieties growing in Hawaii are attacked to the same extent. Similar observations have been made in Egypt and India.

DEPARTMENT OF CITRUS CANKER ERADICATION

Report on Eradication Work for Quarter Ending March 31, 1918

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending March 31st, has been compiled by Mr. Frank Stirling, General Inspector:

Quarter Ending March 31, 1918

Citrus grove trees inspected	3,645,187
Citrus nursery trees inspected	12,943,751
Inspectors employed	246
New properties showing infection	0
Total properties showing active infection	2
Grove trees found infected	2
Nursery trees found infected	0
Counties in which active infections were found	2

General Summary

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914	13,710
Nursery trees found infected since May, 1914	342,254
Number properties infected to March 31, 1918	477
Properties declared no longer "danger centers"	419
Properties still classed as "infected" March 31, 1918	58

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to March 31, 1918:

1914		1915		1916		1917		1918	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1
		Mar.	444	Mar.	49	Mar.	9	Mar.	1
		Apr.	408	Apr.	49	Apr.	169		
May	108	May	1042	May	338	May	52		
June	160	June	772	June	450	June	45		
July	275	July	651	July	349	July	39		
Aug.	1313	Aug	1345	Aug.	219	Aug.	30		
Sept.	767	Sept.	618	Sept.	124	Sept.	6		
Oct.	565	Oct.	214	Oct.	451	Oct.	2		
Nov.	773	Nov.	494	Nov.	131	Nov.	1		
Dec.	366	Dec.	256	Dec.	27	Dec.	1		

DEPARTMENT OF PORT AND RAILWAY INSPECTION

REPORT FOR THE QUARTER ENDING MARCH 31, 1918

The following report on the inspections of shipments and importations, all ports and stations, has been compiled by Mr. K. E. Bragdon, Deputy Port and Railway Inspector.

Two interceptions worthy of special mention have been made during this quarter. On Jan. 2, 1918, Deputy Port and Railway Inspector Emil L. Gehry intercepted at Key West a branch of grapefruit which was infested with the Spiny citrus whitefly *(Aleurocanthus woglumi)*, commonly known as the "Black fly" or "Mosca Prieta", being brought into this country by a passenger from Cuba. On Feb. 16, 1918, Deputy Port and Railway Inspectors G. B. Merrill, U. C. Zeluff and Troy Thompson confiscated a supply of sweet potatoes on a schooner at Eastport, Fla., which had been brought from St. Lucie, British West Indies, and which was infested by the Sweet potato scarabee *(Euscepes batatae)*.

SHIPS AND VESSELS INSPECTED:

From foreign ports	507	
From U. S. ports other than Florida	317	
From Florida ports	382	
Total		1206

SHIPMENTS INSPECTED:

Arriving by water:

Passed	63	
Treated and passed	7	
Returned to shipper	31	
Detained, subject to return by shipper	3	
Contraband destroyed	244	
		348

Arriving by land—Express, Freight, Wagons, etc.:

Passed	335	
Treated and passed	17½	
Returned to shipper	57	
Detained, subject to return by shipper	81	
Contraband destroyed	19½	
		510
Total shipments inspected		858

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	Number of Parcels infested
Citrus scab	Citrus	Spain	1
Cloudy-winged whitefly	Citrus	Cuba	1
Camphor thrips	Camphor	Florida	1
Cherry scale	Peach	So. Carolina	1
Crown gall	Apple	Georgia	1
Crown gall	Peach	Georgia	1
Crown gall	Peach	So. Carolina	1
Dictyospermum scale	Mango	Florida	1
Florida red scale	Citrus	Cuba	1
Florida wax-scale	Ivy	Georgia	1
Greedy scale	Privit	Alabama	1
Ivy scale	Ivy	Georgia	1
Latania scale	Pecan	Georgia	1
Latania scale	Sapodilla	Florida	1
Latania scale	Unknown plant	Cuba	1
Long scale	Citrus	Florida	1
Lesser snow-scale	Mango	Florida	1
Nematode root-knot	Fig	Florida	3
Nematode root-knot	Fig	Georgia	5
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Peach	So. Carolina	1
Oleander scale	Palm	Cuba	1
Oyster-shell scale	Willow	New York	1
Purple scale	Citrus	Cuba	1
Purple scale	Citrus	Florida	2
Purple scale	Mango	Florida	1
Rose scale	Rose	Mississippi	1
San Jose scale	Apple	Georgia	1
San Jose scale	Apple	New York	1
San Jose scale	Cherry	New York	1
San Jose scale	Lilac	Origin unknown	1
San Jose scale	Peach	Alabama	1
San Jose scale	Peach	Georgia	2
San Jose scale	Peach	Ohio	1
San Jose scale	Peach	So. Carolina	2
San Jose scale	Peach	Tennessee	1
San Jose scale	Pear	Georgia	3
San Jose scale	Pear	So. Carolina	1
San Jose scale	Persimmon	Georgia	1
San Jose scale	Plum	Florida	1
San Jose scale	Plum	Georgia	3
San Jose scale	Plum	No. Carolina	1
San Jose scale	Plum	So. Carolina	1
San Jose scale	Rose	Florida	1
San Jose scale	Rose	Georgia	1
Soft brown scale	Ivy	Georgia	1
Spiny citrus whitefly	Citrus	Cuba	1
Sweet potato scarabee	Sweet potato	St. Lucie, B. W. I.	1
Sweet potato weevil	Sweet potato	Cuba	1
Walnut scale	Grape	New York	1
Walnut scale	Peach	New York	2
Walnut scale	Pear	New York	1
Walnut scale	Plum	New York	2
Walnut scale	Plum	Georgia	1
Whitefly	Citrus	Florida	2
Whitefly	Jasmine	Georgia	1
Whitefly	Privit	So. Carolina	1
Withertip	Citrus	Florida	1

PARCEL POST PLANT INSPECTION

QUARTER ENDING MARCH 31, 1918

PARCELS INSPECTED:		
Passed	2179	
Treated and passed	110	
Returned to sender	1	
Detained, subject to return by sender	11	
Infested or infected parcels destroyed	5	
Total parcels inspected		2306

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or disease	Occurring on	From	Number of Parcels infested
Crown gall	Peach	Georgia	1
Crown gall	Rose	Illinois	1
Crown gall	Rose	Ohio	10
Florida wax-scale	Ivy	New York	1
Ivy scale	Ivy	New York	1
Mealy-bug	Coleus	Ohio	1
Mealy-bug	Hibiscus	Ohio	1
Mealy-bug	Rose	Ohio	1
Mealy-bug	Salvia	Ohio	1
Nematode root-knot	Begonia	Ohio	6
Nematode root-knot	Chrysanthemum	Ohio	3
Nematode root-knot	Coleus	Ohio	1
Nematode root-knot	Fig	Florida	2
Nematode root-knot	Geranium	Ohio	26
Nematode root-knot	Grape	Florida	1
Nematode root-knot	Hibiscus	Ohio	4
Nematode root-knot	Kudzu vine	Ohio	1
Nematode root-knot	Rose	Florida	1
Nematode root-knot	Rose	Ohio	57
Nematode root-knot	Peach	Florida	1
Nematode root-knot	Petunia	Ohio	1
Nematode root-knot	Plum	Florida	1
Nematode root-knot	Tomato	Florida	1
Nematode root-knot	Unknown shrub	So. Carolina	1
Nematode root-knot	Verbena	Ohio	2
Oleander scale	Oleander	Ohio	1
Oyster-shell scale	Willow	New York	1
San Jose scale	Plum	Florida	1
San Jose scale	Rose	So. Carolina	1
Soft brown scale	Ivy	New York	1
Whitefly	Citrus	Florida	1
Whitefly	Jasmine	Florida	1

THE ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service:

Ball, Jos. H.	Aviation Section
Barcus, Geo. D.	Aviation Section
Bibby, F. F.	U. S. N. R. F.
Bradford, Horace	Federalized Nat'l Guard
Branam, Jas. R.	Navy
Brown, A. C.	National Army
Brown, Luther	Naval Reserve
Butts, J. L.	Ambulance Corps
Calcote, W. H.	Officers Reserve
Cary, Chas. L.	National Army
Chandler, L. L.	Navy
Dickey, Ed. K.	Officers Reserve
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	National Army
Goldsby, Jack	Ambulance Corps
Green, Guilford	Federalized Nat'l Guard
Grimes, D. W.	Aviation Section
Hansen, H. W. A.	National Army
Harrison, C. J.	Aviation Section
Hood, Richard Van	Lieut., Marine Corps
Howell, John F.	Officers Reserve
Hunt, Chas. M.	Medical Corps
Jackson, Henry C.	Officers Reserve
Lovett, J. C.	Ambulance Corps
Little, Floyd L.	Aviation Section
McClannahan, Howard	U. S. N. R. F.
Maloney, Clarence B.	"Somewhere in Europe"
Miller, Herbert L.	Aviation Section
Moore, Jos. W.	Naval Reserve
Moore, Jules B.	"Somewhere in France"
Neal, Cecil G.	Officers Reserve
Niedernhoefer, Wm. F.	Aviation Section
Roberts, Samuel F.	Navy
Smith, J. G.	National Army
Stephens, Chas. S.	National Army
Swann, Porter R.	Sergt. Cavalry
Walker, Geo. S.	Aviation Section
Wilson, Guy H.	Lieut., Field Artillery

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*.......................................*Editor*

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J. H. MONTGOMERY.......................................*General Grove Supervisor*

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RELATION OF THE STATE PLANT BOARD TO THE WAR.—As the world famine in food becomes increasingly more serious it becomes more and more apparent that the United States, whose economic position is now stronger than that of any of the other belligerents, and after the war will be still stronger by comparison, must at this time consider the future. America has the task of supplying food and raw materials, not only for its own use but for the use of its allies. The agricultural and horticultural interests of Great Britain, France, and Italy are, if not paralyzed, seriously impaired and this condition will continue throughout the period of the war. When peace does come it will find a devastated area where the battles have raged and a broken and battered Europe. During the period of recuperation following the close of the war America will still be called upon to furnish food to her allies, and who knows but that it will devolve upon us to help feed our present enemies? It is an open secret that our military, naval and civil authorities are making preparation for a war of long duration.

Whether it is upon the basis of present war conditions, or of conditions subsequent to the war, the importance of the position occupied by and the work being done by the State Plant Board of Florida and kindred bodies in other states cannot too forcibly be brought to the attention of the public. The production of enormous food supplies, greater quantities than have ever been produced before, is the task that is set for agricultural and horticultural America. If the functions of such bodies as the State Plant Board are great under normal conditions they are even greater and more important under the abnormal conditions brought about by the world war.

It is in the protection of food crops that the work of the State Plant Board bears its closest relation to the war. Not only is the State Plant Board using all its available energy toward preventing the entry of injurious insects and diseases of food crops into the State, but it is making almost superhuman efforts to eradicate or control many of those that are already within our borders. Although these efforts would be made under any circumstances, the present trying situation makes it more imperative than ever that success attend its efforts.

As illustrating what the work of the State Plant Board means to success in war may be mentioned the following:

Cotton, although not a food crop, is needed in enormous quantities as an essential to both civilian and military requirements. The State Plant Board is by all known means endeavoring to retard the boll weevil in its onward march and to prevent the introduction into this State of a still more injurious insect pest of cotton, the pink bollworm.

The sweet potato is one of the South's greatest sources of food supply. The value of this crop in Florida alone is estimated from four to six million dollars annually, and it is of equal or even greater value in the other southern states. This great source of food supply is threatened with extinction by a little insect known as the sweet potato root weevil. The State Plant Board is endeavoring to prevent further inroads of this pest and thus protect and save an important source of food supply.

The State Plant Board is engaged in a battle royal with one of the most insidious enemies of plant life known, citrus canker, which has for four years been threatening the citrus industry with destruction.

There has been a shortage in the world's production of sugar. In view of this shortage it is not impossible that Florida farmers will increase their cane plantings. The State Plant Board is at this time trying to eradicate an insect which attacks sugar cane and which has been discovered in two localities in the State.

Perhaps one of Florida's greatest assets is the vegetable producing industry and yet this industry is in constant danger, daily and hourly, of being wiped out should the Mediterranean fruit fly gain entrance. The only defenses that guard against this invasion are the Federal and State Quarantine regulations, enforced by the inspectors of the State Plant Board, who are on guard day and night at our various ports of entry and railway centers. And so we might go on for pages citing illustrations, one after another, of the importance and significance of the work which the Plant Board is doing. We might mention the possibility of the introduction of the black fly from Cuba, The Bahamas, and other nearby points where it has gained a foothold, and many other pests.

If the work of the Board is important in time of peace, how much more so is it in time of war? We must not think alone of the present but must consider the future. The work being done by the State Plant Board of Florida and by similar bodies in other states is truly one of magnitude and one which is not as a rule appreciated or understood by the public. As we see it, this work is one of patriotism, loyalty and devotion and every loyal Floridian and patriotic American should regard it as a privilege, a right and a duty to aid and support in every way the State Plant Board and its employees in their efforts to protect the horticultural and agricultural interests of the State and Nation.

THE PINK BOLLWORM OF COTTON.—In this issue is published an article on the pink bollworm of cotton, which insect has gained a foothold in Texas. This article was specially prepared by Dr. W. D. Hunter, of the Federal Horticultural Board, who is personally in charge of the work being conducted by the United States Government to eradicate the pest and is now published that growers in the cotton belt may be more fully informed as to the nature of the menace which threatens the South's greatest industry. Readers of this journal are particularly urged to read this splendid presentation of the subject.

As illustrating the seriousness of the situation which confronts the cotton states it may be stated that should the pink bollworm become firmly established in Texas and spread from that state to other states in the cotton belt, the loss would be staggering. Based upon the estimates of damage done by the pink bollworm made by H. A. Ballou* of the Imperial Department of Agriculture for the West Indies, who has made a careful and exhaustive study of the pink bollworm in Egypt, the annual loss which the South would sustain from such an invasion would be in the neighborhood of one hundred million dollars annually.

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*Journal of Economic Entomology, XI, No. 2, page 236, April, 1918.

Ballou found that in Egypt an estimate of a 10% loss was very conservative. Conditions in our southern states are certainly as favorable for the development of the insect as those in Egypt and perhaps would prove to be more so, so that with a twelve-million-bale crop of 20 to 30-cent cotton the probable amount of the monetary loss is easily estimated.

The State Plant Board has established a quarantine against cotton and cotton seed from points west of the Mississippi River in order to prevent the introduction of this pest into our state. Cotton planters are urged to be extraordinarily careful to avoid ordering seed from west of the Mississippi, for no matter how vigilant and careful our inspectors may be, there is always the possibility of a shipment slipping by and this very shipment might be the means of introducing the pink bollworm into this section of the South.—J. H. M.

ORIENTAL PEACH MOTH.—Another dangerous fruit pest, new to the United States, has been discovered. This time it is an insect, the Oriental Peach Moth *(Laspeyresia molesta,* Busk*)*. Its present distribution covers small areas in Virginia, Maryland, District of Columbia, New Jersey, New York City, Long Island, and Stanford, Conn.

Available information indicates that it was introduced into the United States from Japan on flowering cherries, peaches, or other fruits, about 1911 or 1912, or before the Federal Plant Quarantine Act became effective. Its present known hosts are peach, cherry, plum, apricot, quince, pear and apple. The larvae, small caterpillars, severely injure the twigs, and also attack the fruit very much as does the apple-worm, or codling moth.

This pest will become a serious menace to the deciduous fruit industry unless checked or controlled. At the present time the Bureau of Entomology is engaging all available entomologists and sending them into the fruit-growing sections of all states looking for this and other pests. Messrs. C. H. Alden and Harry S. Saidel, of the U. S. Bureau of Entomology, are the entomologists doing the scouting work in the peach orchards of Florida, assisted by the inspectors of the Plant Board.—E. W. B.

SWEET POTATO REGULATIONS.—That the other southern states are awaking to the danger which is threatening the sweet potato industry in the form of the sweet potato root weevil* and are realizing the necessity of protecting the industry from serious

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**Cylas formicarius* Fab.

injury and loss is evidenced by the enactment by the states of Alabama, Louisiana, Georgia and South Carolina of certain regulations and restrictions governing the movement of sweet potato tubers and plants both within and into these states. Each of these states, following the lead of Florida, has made and published through the proper authorities restrictive orders intended to prevent the further introduction and spread of this insect which has proven to be so destructive where it has become established.

On account of these quarantine restrictions Florida growers are cautioned not to undertake to make shipments of sweet potato tubers, plants, vines, cuttings or draws into other states without first ascertaining what the regulations in force are. Otherwise they incur possibility of loss or damage to such shipments from being held up for non-compliance with what are believed to be reasonable and necessary protective measures. Prospective shippers should, for full details as to what these quarantines are, apply to the following as representing their respective states:

Alabama—G. C. Starcher, State Horticulturist, Auburn, Ala.

Georgia—A. C. Lewis, State Entomologist, Atlanta, Ga.

Louisiana—W. E. Anderson, Acting Entomologist, Dept. of Agriculture and Immigration, Baton Rouge, La.

South Carolina—A. F. Conradi, State Entomologist, Clemson College, S. C.

THE QUARTERLY BULLETIN

State Plant Board of Florida

Vol. II JULY, 1918 No. 4

THE ROLL OF HONOR

The following employees of the State Plant Board of Florida are serving in the several branches of the military service as indicated:

Baker, Byrd O.	Quartermaster Corps
Ball, Jos. H.	Aviation Section
Barcus, George D.	Aviation Section
Bass, Clarence A.	U. S. N. R. F.
Bibby, F. F.	Naval Dispensary
Branam, James R.	U. S. N. R. F.
Brown, A. C.	Veterinary Section
Brown, Luther	Naval Hospital Service
Brown, Merle R.	National Army
Butts, John L.	Aviation Section
Bynum, Eli K.	Infantry
Calcote, Wm. H.	National Army
Carothers, A. B.	National Army
Cary, Chas. L.	National Army
Chandler, Luther L.	U. S. N. R. F.
Clark, Virgil I.	U. S. N. R. F.
Dickey, Edward K.	Aviation Section
Dickson, Albert M.	Officers Reserve Corps
*Donaldson, Wilson T.	Aviation Section
*Dukes, Redding A.	National Army
Fish, Robert E.	Aviation Section
Fletcher, J. M.	Aviation Section
Fogg, Harry W.	Engineers Service Battalion
Goldsby, Jack K.	Ambulance Corps
Green, Guilford	National Army
Grimes, D. W.	Aviation Section
Hansen, Hans W. A.	National Army
Harden, John C.	National Army
Harkins, Donald L.	Balloon Corps

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*Died in performance of duty.

Harn, Sam P.	U. S. N. R. F.
Harrison, Cyrus J.	Aviation Section
Henderson, Francis M.	National Army
Holland, Ed. Alton	Ammunition Train
Hood, Richard Van	U. S. Marines
Howell, John F.	Officers Reserve Corps
Hunt, Chas. M.	Medical Corps
Ingram, Otis D.	National Army
Irwin, Harry M.	Mil. Training School, N. A.
Jackson, Henry C.	Officers Reserve
Little, Floyd L.	Aviation Section
Lovett, James C.	Medical Corps
Maloney, Clarence B.	Royal Flying Corps
McClanahan, Howard S.	U. S. N. R. F.
McCullough, James D.	National Army
Milledge, Stanley	National Army
Miller, Herbert L.	Aviation Section
Moore, Joseph W.	U. S. N. R. F.
Moore, Jules B.	National Army
Neal, Cecil G.	Officers Reserve Corps
Niedernhoefer, Wm. F.	Aviation Section
Oliphant, Ross G.	Tank Division
Parker, Frank R.	U. S. N. R. F.
Roberts, Samuel F.	Naval Hospital
Robinson, Tom	Quartermaster Corps
Robinson, Vernon K.	Mil. Training School, N. A.
Scott, Wm. J.	Hospital Corps
Seeds, Harvey W.	National Army
Sherman, Chas. D.	Ambulance Corps
Smith, Clyde	National Army
Smith, Joseph G.	National Army
Smith, Lawrence O.	National Army
Steil, Fred H.	Aviation Section
Stephens, Charlie S.	National Army
Stevenson, Geo. A.	U. S. N. R. F.
Swann, Porter R.	National Army
Thompson, Troy	National Army
Walker, Geo. S.	Aviation Section
Wilson, G. H.	National Army
Wood, Harry E.	U. S. N. R. F.

THE THEORY AND PRACTICE OF SANITARY PRECAUTIONS IN GROVE AND PACKING HOUSE OPERATIONS

JOHN C. HOLTON
Assistant General Inspector, State Plant Board.

PART 1

THEORY OF SANITARY PRECAUTIONS

During the time the writer has been in Florida, he has become convinced that a considerable amount of improvement can be made in the methods of handling both our citrus groves and citrus fruits, in order that the industry may not only be more thoroughly protected against injurious insects and diseases but also that the crop may reach the market in better condition and consequently bring a better price to the grower. What it is desired to bring to the attention of the reader in this article is the question of more sanitary methods in the handling of grove properties and the handling of the crop. The principle involved is not a new one by any means, but has been recognized by the Citrus Exchange and a number of independent packers, by most of the leading growers of the State, and by the authorities who have given close study to all phases of citrus production. For example, a bulletin upon "The Diseases of Citrus Fruits", under the authorship of Professors P. H. Rolfs, H. S. Fawcett and B. F. Floyd, published by the University of Florida Experiment Station in November, 1911, summarizes as two cardinal principles in reducing citrus fruit diseases, the following points: "Some of these troubles can be overcome only by better grove sanitation and hygiene." "Wherever possible a disease should be prevented rather than allowed to occur." It is doubtful if more eminent authorities on the subject of citrus diseases in Florida than those just quoted could be found.

The employment of sanitary methods has a quadruple bearing upon the industry. They have to do, first, with the improvement of the condition in which Florida citrus fruit reaches the market; second, with preventing the spread of diseases and insects from one grove to another and from one locality to another; third, their effect in facilitating the final eradication of citrus canker from the State; and, finally, protection of the industry against the spread of diseases which may be introduced into the State, accidentally, of course, in future years. We would prefer to discuss these under separate heads.

1. Many of our readers may have had the same experience as the writer when visiting fruit markets in northern states. Florida citrus fruit can usually be distinguished from all other fruit at a distance of several hundred feet, simply because it does not present a bright, clean appearance, and it is only the man who has found out by experience the excellent quality of what is *inside* of the rind of the Florida fruit who is the habitual buyer. It seems to us that the time is here when systematic effort should be made to improve the appearance of the Florida fruit, thus enabling it the better to hold its own in competition with citrus fruit from other sections of the United States. Insects and diseases are the principal causes of the discolored and unsightly condition of much Florida fruit that is shipped to the North. While it is true that this condition cannot be remedied without bringing about a more satisfactory control of the insects and diseases now in our groves, it is also true that steps should be taken to prevent aggravation of the present condition, which will undoubtedly result if we permit more and more insects and diseases to enter our groves.

There is also the question of decay and loss of fruit in transit. A consignment of fruit free from decay will bring a uniformly higher price than a shipment consisting of sound and decayed fruit together. In other words, loss from decay in transit is not alone loss of the fruit which is decayed, but the general price of the remaining fruit is lowered. The time was when approximately ten per cent of the Florida fruit shipped to the North was lost through decay and molds. Through the educational campaign conducted by the Florida Experiment Station for the past few years and as the result of better picking and packing house methods, particularly more careful handling of the fruit than formerly, this loss has been greatly reduced. On the whole, taking into consideration all shipments and one season with another, it is likely that the loss from these causes is still in the neighborhood of five per cent. Assuming that the normal citrus crop of Florida is 8,000,000 boxes and that the growers receive an average price of $2.00 per box, a loss of five per cent means an annual loss of $800,000.00 on the Florida crop. We have been reliably informed that a number of growers and packers, through the adoption of better methods in handling the crop and in packing it, have succeeded in reducing this percentage of loss to approximately one per cent. That even this small loss can be reduced by still further improvement in the methods of handling the crop is practically self-evident. From a purely financial standpoint, therefore, the adoption of more sanitary measures cannot result otherwsie than in increased profits to the grower.

Among the causes for damage and deterioration of fruit in transit may be mentioned several fungus diseases, the most important of which is usually the blue mold. The term "blue mold" is applied to the damage by one or more fungi which are closely related. The distinction between these fungi need not be discussed at the present time, for their action is practically the same and the methods of dealing with them are the same. The spores of these fungi enter the fruit through clipper cuts, wounds or bruises of the rind, or through injuries made by other diseases, and after entering the fruit they increase and multiply, causing decay. The spores of blue mold are quite generally distributed through groves and packing houses, their relative number being very largely dependent upon the measures employed to dispose of moldy fruits and to prevent contamination of clean fruit by moldy fruit. In experiments made by the Florida Experiment Station several years ago, the great importance of preventing injuries through which these fungi could enter the fruit was clearly established, and as a result of those experiments much better methods of handling the fruit to protect it from injury have come into vogue generally throughout the State. If the fruit could be handled from the tree to the market without clipper cuts, injuries or bruises, there would be no loss due to blue mold, for there would be no way in which the blue mold fungus could gain access to the interior of the sound fruit. Care in handling is therefore of the utmost importance, but one hundred per cent efficiency in this regard cannot be secured. Therefore, if this care to avoid injury to the fruit be supplemented by thorough cleanliness in the packing house and by the use of disinfectants to destroy fungus spores in field boxes, washing tanks and packing houses, a still greater reduction of loss from this source will inevitably follow. As illustrating this, we may cite the case of one packing house in which the loss from blue mold of fruit enroute to market averaged from two to five per cent. Measures of cleanliness in the packing house were adopted, field boxes were scrubbed once a week with soap and water and at the same time more care was employed in the handling of the fruit between the grove and the packing house. The result was that the loss from blue mold was reduced to one per cent. This reduction was brought about purely by cleanliness and without the use of disinfectants. How much more then would the loss have been reduced, perhaps to a point inappreciable, had disinfectants been used along with the cleansing work to destroy the blue mold spores?

In a recent conference with Professor P. H. Rolfs, Director of the Florida Experiment Station, regarding this matter, Professor Rolfs expressed the opinion that in reducing the loss from blue mold, dipping of field boxes in a disinfecting solution would be of the first importance, cleanliness of second importance and care in handling the fruit, third. However, all of these matters go hand in hand and a combination of them should practically eliminate losses from blue mold. In fact, Professor Rolfs has stated that careful handling and absence of clipper cuts, coupled with sanitary disinfecting measures and cleanliness, should reduce the average loss by blue mold to less than one per cent.

Another cause of the decay in citrus fruits enroute to market is the stem-end rot, which is caused by the same fungus that produces melanose on the leaves. The form of the fungus which grows in dead wood produces spores which are responsible for stem-end rot and also for the melanose form of the disease appearing on the leaves. The fungus is not able to penetrate green fruits but does penetrate as the fruit ripens. Owing to the damage to trees by the cold weather during the past two years, melanose is unusually abundant this year, and should weather conditions be favorable to its development during the picking season, we may this year expect an unusually large amount of stem-end rot. We are not able to recommend measures which are a complete panacea for all troubles to which citrus fruits are heir, and it must be frankly admitted that the dipping of field boxes in disinfecting solutions will probably have no effect in preventing the development of stem-end rot between packing house and market. This is true for the reason that the fruits are in most cases already infected with the disease when they come to the packing house. It is true, however, that in the grove the fungus can enter the stem of the fruit where the latter is removed by the clippers, and the fungus causing stem-end rot can make its way through at least three inches of twig from the clipper cut to the fruit itself. A stronger argument could not be adduced to show the value of keeping the clippers disinfected when removing the fruit from the trees. This is only another application of the sanitary, antiseptic idea.

Anthracnose to a small extent develops on fruit enroute. The anthracnose spots on the rind sink in if conditions are cool and moist and these spots afford entrance for the blue mold fungus.

Nail-head rust is caused by the same fungus which causes scaly bark, usually in the presence of the withertip fungus. It is doubtful if the nail-head rust markings continue their development in transit, but these nail-head spots afford entrance for the blue mold. It will be noted, therefore, that the entire question, in so far as decay of the fruit is concerned, is a complicated one in which several different diseases take part and that some of these diseases are agencies through which other diseases may accomplish their nefarious work. Aside from those mentioned, which are quite familiar to all citrus growers, it is advisable to take into account other fungi that are present in the State and should be kept in subjugation as much as possible for the reason that they may at some future time become more virulent and hence more destructive than they are now. Such a disease is the Diplodia rot. This fungus is present in Florida in considerable amount but does not apparently cause much fruit rot. Like other plant diseases this disease might increase in virulence and become of first rank among those responsible for these losses.

Aside from the question of thorough cleanliness, we might say that the dipping of field boxes after each lot of fruit is emptied, using a suitable disinfectant for the purpose, prevents contamination from one lot of fruit to another and protects fruit from clean groves when this fruit is hauled in boxes previously used in groves where these diseases are prevalent. Of course disinfecting of the field box is but one step in keeping down these diseases, and it is proper to suggest also the use of some disinfectant in the water used for washing fruit, such, for example, as using one (1) per cent. of bluestone in water for the washing, or adding one-fourth of a pound (¼ lb.) of permanganate of potash to one hundred gallons of the wash water. It would also appear advisable, in the light of our knowledge regarding these molds and decays, to make rather liberal use of a disinfecting solution in sprinkling the packing house floors prior to sweeping. Sprinkling of floors to keep down dust is in common practice, but the use of a disinfecting solution to destroy the fungus spores would be an added benefit. For this purpose could be used formaldehyde, one part of 40% formaldehyde to

90 parts of water, a 5% solution of carbolic acid, or a 2% solution of bluestone.

2. Field boxes and field equipment are among the most effective agencies for spreading diseases and insects from one grove to another and from one neighborhood to another. Scaly bark, prior to the adoption of the quarantine rules by the Plant Board, was spread to many neighborhoods in Florida, and in many of these cases the evidence available indicates quite conclusively that the introduction was due to the use of ladders that had previously been used in groves infected with scaly bark. Incidentally, has it ever occurred to the reader that the picking ladder is perhaps the most diabolically complete apparatus that could be devised for infecting trees with any fungus or bacterial disease which enters through abrasions of the bark? The field box is a potent agency in spreading scale-insects and white flies of the different species. All scale-insects in their early stages are tiny crawling lice. They can live without food for several hours, and some of them for several days, so when they are placed in a field box with fruit from an infested tree they can remain in that box until the box is emptied and sent to a grove somewhere else. Cottony cushion scale particularly is readily distributed in field boxes. Thus far we have found eighty-seven species or kinds of scale-insects in Florida and of these twenty-nine kinds attack citrus. All of these in one grove would make fruit from that grove absolutely unmarketable, yet all of them are gradually spreading under present methods of handling the groves and crops and ultimately the majority of them will be in each and every grove unless better methods are adopted to prevent their general dissemination. Distribution of both diseases and scale-insects through the agency of field equipment, and particularly ladders, bags and field boxes, can be practically prevented if these things be disinfected at proper intervals.

3. In relation to the eradication of citrus canker, we believe it can safely be said that the turning point towards victory has been reached. In all there have been 478 properties in the State which have been found infected with the disease. The Plant Board has already declared as no longer danger centers 432 of them, or 90%. This declaration by the Board is equivalent to stating that in the opinion of the Board canker has been eradicated from these properties. There are still 46 properties in the State classed as infected, and if we could be sure that there are no infections in the State other than those we have

discovered and that we have under quarantine, we could almost guarantee that eradication of the disease would be completed within the next two years. However, there may be other infections that we have not discovered. The reader will naturally ask why we have not inspected all of the citrus properties in the State to find out whether they are infected. There are over 10,000,000 citrus trees in the groves of Florida, and to make one inspection of them with the largest force of inspectors we have ever had would require several years' time. The truth of the matter is that it has taken nearly all of our available funds and nearly all of our inspectors to stamp out the infections which have been discovered, and it is only as we make more and more progress in cleaning up these centers of infection that we have any inspectors available to undertake the advance or scout inspection of areas not hitherto inspected.

We also know that we have never been able to secure a complete record of all the citrus trees that were shipped from canker-infected nurseries. Some of the shipments that escaped us, and which we have never been able to locate, may be somewhere in Florida today with citrus canker on them. There are several possible ways in which infection may have become established without our finding out about it. Trees may have been sneaked into the State from infected localities in the baggage of individuals, or in the earlier days infected fruit may have been shipped to different parts of Florida.

The point we wish to impress upon the reader is, that if any such undiscovered infections are in existence, spread of canker is taking place from them almost daily by reason of laborers, teams, fruit buyers and others entering those properties and then going to other properties. Unless we adopt and put into practice everywhere methods which will stop the spread of canker from the undiscovered infection, we do not know how long it will be until we complete the eradication of canker. The only way the grower can protect himself against the undiscovered infection is to so handle his property that citrus canker cannot get into it, no matter from what source or in what way it may come. This means, of course, the employment of sanitary precautions in the handling of his grove property, and the sooner the growers in general adopt these measures the sooner will the eradication of canker be completed and money saved, not only to the fruit grower but to the general taxpayers throughout the State.

4. Many of our groves are veritable zoological gardens and pathological museums in the variety and number of insect and fungus diseases present therein. It is, nevertheless, a fact that there are many destructive insects and diseases which we do not yet have. If any of these are accidentally introduced in the future despite all of the quarantine work of the State authorities, they will spread just as diseases have spread in the past unless the growers take measures to forestall them. The brown rot fungus is not known to be in Florida, but if it should ever be introduced it would be difficult for the growers to detect its presence because of its close similarity in the gummosis form to bark diseases of citrus which we already have. The disease might easily attain a wide distribution before its dangerous nature is recognized and special steps taken to suppress it. A disease such as this, which may cause a loss of 25% of the fruit enroute to market, is to be guarded against in every way possible.

In Jamaica, Cuba, the Panama Canal Zone, and the Bahamas is an insect known as the spiny citrus white fly, or black fly, closely related to our own white fly but many times more destructive. There is every reason for believing that under Florida conditions it would be as serious a menace as citrus canker. It does not confine itself to citrus trees, however, but is destructive to the mango, guava, sapote, and many other trees. Of course we are trying to keep it out and will continue to try to keep it out to the utmost of our ability and resources, but should it by any chance get into any citrus grove in Florida the field box would, under present conditions, immediately become the means of spreading it from grove to grove and from county to county. The use of sanitary precautions and the disinfection of field equipment is, therefore, good insurance against the wholesale distribution of pests and diseases which threaten us from the outside, and which when they do get into Florida will be in and at work before their presence is discovered.

PART 2

PRACTICE OF SANITARY PRECAUTIONS

On October 8, 1917, the State Plant Board passed its Rule 36 covering the subject of disinfection of field boxes used in public fruit packing houses. This rule was later amended. On June 10, 1918, the Board suspended the operation of Rule 36 for a period of one year. The Board, in taking this latter action, did so as a war measure, feeling that with the existing shortage of labor, the use of any large number of men in any horticultural activity which does not directly and immediately result in increased production of food crops is unwise. The application of the instructions issued under the provisions of Rule 36 would require the employment in the packing houses of the State of Florida of perhaps several hundred men, and since the benefits accruing from the disinfection of field boxes can hardly be regarded as immediately and directly influencing food crop production and the services of these several hundred men can be used to greater advantage in other ways, such as in shipbuilding, munition making, planting, cultivating and harvesting food crops, the Board took the action above referred to and suspended the operation of the rule, at the same time reiterating its belief in the efficacy of sanitary precautions in packing house operations as a means of preventing the spread of diseases and insect enemies of fruit trees and urging all packing house operators to make use of the prescribed measures when practicable to do so.

It seems desirable, therefore, at this time and following the action of the Board, to give to the fruit-growing public and to the interested packing house operators, as briefly as possible, the results of the observations made and the experience gained in the actual application of the measures advocated.

The reasons why sanitary precautions should be practiced in field and packing house operations have been set forth so clearly and concisely in the section devoted to the Theory of Sanitary Precautions, that it seems hardly necessary to dwell further on this subject. However, it may be of interest to refer to the conception of the idea which later developed into the present rather complete plan of grove sanitation, and to briefly follow the growth and development of this idea. Like many other things which eventually amount to something, the origin of the plan of using sanitary precautions, that is, precautions by cleanliness to prevent injury to trees and products, goes back to the period when damage to trees was first caused by diseases and pests.

THE EVOLUTION OF THE IDEA OF SANITARY PRECAUTIONS

In the earlier history of horticulture, no doubt man attempted to combat the ravages of diseases and pests by crude efforts along the line of prevention. In more recent years, the knowledge that diseases of trees were often caused by micro-organisms led to the use of methods of treatment looking not only to cure, but prevention. Frequently methods of treatment were used which were effective, and no doubt the method was given credit for curing, whereas the cure was effected by the removal of the diseased part, and the prevention of recurrence and of further spread was the result of the application of the "cure" or "remedy".

The idea of preventive treatment of diseases and pests in orchards has, without much blare of trumpet, kept up with other progressive movements in modern science, and the practical horticulturist has not been slow to accept and use the suggestions made from time to time by those engaged in research work. Here in Florida the citrus fruit grower has for many years been making use of methods in his grove operations which, while not recognized as such, were in reality the rudiments of what is now rather commonly referred to as "sanitary precautions in grove operations". The greatest advance in the direction of grove sanitation has been made during the past few years, and the reason for the progress is without question directly traceable to a calamity—the introduction of citrus canker into Florida. The introduction of this disease which threatened the citrus industry with destruction, and the eradication of which has for four years been the one big thing in the minds of the citrus growers of Florida, was little short of a disaster. The actual money loss incident to the introduction of citrus canker, if it were possible to compute it with any degree of accuracy, would doubtless run into many millions of dollars if we include, in addition to the cost of the eradication campaign and the destruction of trees, the depreciation of property values in many sections of the citrus-producing area. Yet this very disaster has served to bring the growers of Florida into a closer relation with each other, was the cause in great measure of the enactment by the Legislature of an adequate and, in many respects, a model horticultural law, and has resulted in many other benefits to the fruit industry. Not the least of these benefits is the higher development of the idea of grove sanitation and the creation of a healthy sentiment in support of this idea. At the risk of repeating what is perhaps a familiar story to many, it may be well at this time to go somewhat into detail as to the growth and development of the idea of sanitary precautions covering the period of the past several years.

In the summer of 1914 the citrus growers in South Florida were themselves handling the campaign to eradicate citrus canker, the disease not having been known to exist at that time anywhere in the State except Dade County. There seemed to be very little progress made. It was noted that whenever an infected property was found by inspectors, upon reinspection additional trees were found infected. This happened no matter how carefully the property was inspected the first time. It must be remembered that there was very little known about citrus canker. In fact, at this time there had been no public announcement made that the disease was caused by a micro-organism. However, when the laboratory investigations disclosed the fact that the disease was caused by an organism, this, in connection with the fact that cankered trees had been so frequently found in large numbers on inspections made subsequent to visits by inspectors, led many of the thinking growers to the conclusion that the inspectors and owners were themselves carrying canker. As an evolution of this thought, efforts were made to so disinfect the inspectors as to prevent the carriage of the disease. These efforts were at first very crude indeed, consisting of the use of a small hand spray, such as is used by amateur gardeners, for spraying the inspectors' clothing, especially the lower extremities and shoes, with a solution of bichloride of mercury. With time the idea of the thorough disinfection of inspectors' clothing developed further, and with increased knowledge derived from both field and laboratory investigations it was finally determined that the only proper course to pursue was to treat the inspectors who visited infected as well as non-infected groves very much as though they were surgeons or nurses entering an operating room for the purpose of performing an operation. In other words, when an inspector entered a citrus property he was perfectly clean so far as disinfection of his outer clothing was concerned. This result was obtained by means of his wearing a one-piece suit which had previously been dipped in a solution of bichloride of mercury, a head covering similarly dipped, and leggings and shoes which had been disinfected. The disinfection was even carried to such an extent that the hands, face and neck of the inspector were bathed in the bichloride solution. Inspectors were not allowed to touch the trees when possible to avoid doing so. It is significant to note that, with the adoption of these methods of personal cleanliness, or disinfection, in conjunction with the immediate destruction of trees when found to be infected, begins the period when we made some headway against the inroads of citrus canker.

Another evolution of the same idea of disinfection evidenced itself in the restrictions which were placed upon the operations conducted in infected properties. All work done in properties which were found infected with citrus canker was done under certain precautions which were prescribed by representatives of the State Plant Board. Workmen were required to be as particular and as careful in the disinfection of their clothing as were the inspectors themselves and all tools, vehicles and other equipment used in the infected property were thoroughly disinfected. It may be well said that the successful eradication of citrus canker is dependent upon careful inspection, destruction of diseased trees immediately when found, personal disinfection of inspectors and workmen, and the conduct of the work in infected properties in a sanitary manner. Practically all operations in groves and nurseries where infected trees are found are carried on for long periods under such precautionary measures as outlined above, and when an individual, horse, or mule leaves such properties he is thoroughly disinfected.

Disinfection of Field Boxes

Among other measures made use of in the eradication campaign was the requirement that owners of citrus canker infected properties must immerse in an antiseptic solution all field boxes used in picking fruit and also that all public packing house operators in the vicinity of infected properties should follow the same practice. We are confident that this procedure has contributed in a great measure in preventing further distribution of citrus canker. As a material evolution of all of the above practices, that is, of the disinfection of equipment, of individuals and field boxes to prevent the spread of citrus canker, the thought occurred to many of the more progressive growers of the State and to the staff of the State Plant Board, that if such practices were beneficial as applied to citrus canker, why would they not be equally so if applied in an effort to prevent the spread of other diseases caused by organisms? And why not also practice these methods to prevent distribution of injurious insects? This feeling among the more progressive growers of the State has, during the past two years, developed and grown to such an extent that the disinfection of field boxes and other equipment is now strongly advocated and is being practiced by many growers and packing house operators. This advocacy primarily of course being for the purpose of preventing the distribution of citrus canker from any undiscovered foci; at the same time it seems now to be a well recognized fact among growers and packing house operators that diseases of various kinds and insect pests affecting fruit trees may, in great measure, be prevented from being distributed if field and packing house equipment are disinfected.

The various agents of the State Plant Board, stationed in different sections of the State, from time to time reported to the Gainesville office the growth of this sentiment. The Plant Commissioner's office was in receipt of many letters from prominent growers in the State advocating the use of sanitary precautions in grove operations, many growers requesting that a rule be passed by the Board which would require the disinfection of field and packing house equipment, more especially such packing house equipment as was used by the public packing houses, the danger in this particular instance being regarded as especially great on account of the wide distribution which field boxes used in public packing houses usually attained. After a thorough canvass of the situation it seemed advisable to the Executive Staff of the Plant Commissioner's office to recommend to the Plant Board the adoption of a rule covering this subject and the Plant Board, after very careful consideration of the information submitted to it, acceded to what appeared to be a very strong demand on the part of the growers of the State and enacted Rule 36.

APPLICATION OF SANITARY MEASURES IN PACKING HOUSE OPERATIONS

Under the provisions of Rule 36 the Plant Commissioner issued certain instructions requiring that all public packing houses engaged in packing citrus fruit install suitable dipping vats or other apparatus for the purpose of disinfecting, by immersion in a disinfecting solution, each and every field box in which fruit is brought to such packing house. The Plant Commissioner also prescribed certain disinfecting solutions, the chief of which was a solution of bichloride of mercury at a strength of 1 to 1000.

As previously mentioned, Rule 36 was formulated and passed by the Board in response to a general demand on the part of the growers of the State for some action along this line, and as a result of observations made throughout the State by the Plant Commissioner and his assistants as to the practical operation of certain precautionary measures in use in communities where citrus canker has been prevalent and which measures were instituted for the purpose of preventing the possible distribution of this particular disease.

Since the passage of Rule 36 this office has received many commendatory expressions and assurances of earnest cooperation from growers and packers in various parts of the citrus belt. The consensus of opinion among growers seems to be that in the passage of this rule the Plant Board made a very long stride indeed in the direction of further protecting the citrus industry.

In some quarters the impression has prevailed that the disinfection of field boxes involved the use of complicated apparatus and machinery, the use of considerable extra labor and the incurring of quite an additional expense to the packing house operators. This impression is wrong. It was and is suggested that packers confine their installations to as simple and inexpensive apparatus as possible for the present. As a result of the experience obtained during the first season of operation, the operator will be in better position to determine his requirements and the nature of the outfit best adapted to his use. No doubt the use of conveyors, belting, diverters and other apparatus will ultimately prove advantageous. Perhaps some packing house operators will even at this time know their needs to such an extent that they can at once extend their equipment to meet the new demands, thus being able to more efficiently and economically handle the dipping of field boxes. It must be remembered, however, that the arrangement of packing houses is by no means uniform. It is impossible for the Plant Commissioner's office to give advice or information which would apply to all packing houses as to the arrangement of any equipment which the instructions in regard to the disinfection of field boxes may require. The problems in connection therewith must of necessity be solved in accordance with the arrangement of the present packing house equipment.

The simplest device suggested for the disinfection of field boxes consists of a cypress vat or tank 7½ feet long, 3 feet wide and 2½ feet deep, located close to the place where fruit is received and dumped, with a drain board of the same width as the vat placed at one end of the vat and slightly inclined so that the excess solution may drain back into the tank after the field boxes are dipped and placed on the drain board. When possible, this vat or tank is located at the side of the dump so that the man operating the dump can also immerse the field box, which in many instances eliminates the services of an extra laborer. As has been found by experience, the truck man hauling in filled boxes to the dump man can at the same time remove the empties on his return trip. The Plant Commissioner, in a letter of instructions addressed to all packing house operators of the State last season, made the above suggestion and it apparently met with the approval of a large per cent of the operators. The size and shape of the dipping vat is of minor importance. The wooden vat seems to be preferable to the metal vat and is more generally used. Among the more recent improvements made on dipping vats is an outfit devised by the manager of the Winter Haven Citrus Growers' Association, which consists of a box made of wood mounted on low wheels so that it can be moved from one place to another in the packing house. One concern manufacturing packing house equipment has constructed a mechanical device for the disinfection of field boxes. This was used in several packing houses last season with apparently good results. There are many operators in the State who have given much study to this subject, and doubtless in the near future the packers of the State will be offered a device more economical and practical than anything yet devised.

COST, ETC., OF DISINFECTING FIELD BOXES

As the packing season of 1917 and 1918 was drawing to a close, after Rule 36 had been in operation for some time, it was decided by the Plant Commissioner and his assistants to procure first-hand information from the packing house operators themselves in order to ascertain how the practical application of the instructions issued under Rule 36 was working. To accomplish this object, representatives of the Plant Board called upon the packing house operators in their respective districts and presented a series of questions pertaining to the season's operations. There are on file in the office at Gainesville the names of 414 individuals, firms or corporations listed as operators of packing houses in the State. We have received definite reports from 166 of these packing houses. Of the 414 packing houses listed, approximately 200 operated during the season of 1917 and 1918. Many of the packing houses were not operated last season, as the fruit crop was greatly reduced in some sections as a result of the cold spells of 1917 and 1918. The results as tabulated from the 166 reports received are very gratifying. These reports were from packing houses operating in 18 of the 24 citrus producing counties of the State. As stated, 166 packing houses made reports. Of those reporting, 81, or practically 50%, complied fully with the instructions issued under Rule 36. The vast majority of the operators from whom reports were received endorsed the idea of sanitary precautions in packing operations. Sixteen operators expressed disapproval. Others were non-committal. We note further that 24 operators who had not previously done so signified their intention to install dipping vats before the opening of the packing season of 1918-1919.

A few packing house operators have advanced two objections which are worthy of note, namely, that of cost and of supposed damage to the field boxes by reason of dipping them in the disinfectant. The matter of cost must of course be given due consideration, although experience has shown that the cost of operating under sanitary precautions is so little as to be hardly worth considering. The figures given in this article are authentic, having been obtained from packing houses that actually installed dipping vats and disinfected field boxes last season. One of the most striking reports that has been called to our attention comes from Mr. J. B. Booth, manager of the Tavares Exchange packing house, which packing house made use of sanitary precautions in their entirety throughout the season of 1916-17, as well as the season of 1917-18. It has been found that the added cost of immersing field boxes in bichloride solution in the Tavares house is ¼ cent per packed box and the total cost covering disinfection of all field equipment, including boxes, bags, ladders, clippers and the one-piece suits worn by pickers is about 2/3 of a cent per box. From the reports sent in by the District Inspectors of the Plant Board, after calling on the packing house operators in person, we find that of the 49 operators who made reports as to the cost of dipping field boxes last season, 37 report the cost as not exceeding $5.00 per 1000 boxes or ½ cent per box or less. The total cost of dipping field boxes ranges from $12.50 per 1000 to $1.60 per 1000 boxes. The lowest figures submitted were received from Mr. D. H. Duggins, manager of the Ozona Citrus Growers' Association, where a mechanical device was used to disinifect the field boxes. There are other packing house operators, though, who have also reduced the cost to a very low figure. The report of Mr. F. B. Rainey, manager of the Ft. Green packing house, shows the remarkably low cost of $2.00 per 1000, or 1/5 cent per box. Mr. L. B. Skinner of Dunedin, Florida, reports that the total cost of disinfecting field boxes last season in his packing house was $2.35 per 1000 boxes, or a trifle more than 1/5 cent per box. A general average of cost based on the forty-nine reports filed by the packing house operators, previously referred to in this article, representing nearly every citrus growing county in the State, is $5.00 per 1000 or ½ cent per box. These figures come from all kinds of packing houses ranging from the smallest to the largest, with no uniformity as to size, shape or equipment. It is interesting to note that the lowest figures submitted come from operators who have installed some mechanical device. Most operators dipped by hand and the cost was in every case greater, using the same disinfectant, than where a mechanical device was used. A number of operators when called upon to furnish an estimate of the cost of disinfection replied that the cost was too small to be accurately estimated. We think that it is a safe conclusion that the cost of using *all* sanitary measures advocated in packing and handling citrus fruits will not exceed one cent per box of packed fruit.

DETERIORATION OF EQUIPMENT

There is practically no deterioration of the metal parts of the boxes on account of dipping in a bichloride solution. Our observation has been that field boxes which were repeatedly dipped at packing houses over the State last season show that the boxes are in no worse condition on the average than similar boxes which were not dipped. For the purpose of determining the effect of the corrosive sublimate solution (1 part to 1000) used in dipping boxes, several experiments were conducted here in the office at Gainesville. Metal stripping dipped in the solution every third day for three months, and both stripping and cement nails dipped four times daily for three weeks were discolered but showed no marked corrosion. In neither of the above tests was any appreciable injury noticeable. In fact, several months after the above experiments were conducted, the same pieces of metal that were used previously are now being dipped as before and hung in the open where the sun and air can gain access to the metal, and still show no appreciable injury.

The conclusion is that both from experience in the packing house and the office tests the deterioration is so slight that it is hardly worth considering.

DISINFECTING SOLUTION

As to the solution best adapted to the disinfection of field boxes and field equipment nothing better has so far been found than bichloride of mercury, of a strength of 1-1000. This strength is obtained by the addition of eighty grains of commercial bichloride to each gallon of water, or one pound to ninety-eight gallons of water. This is the solution advocated by the Plant Commissioner and is in general use throughout the State. Other solutions have been used but bichloride of mercury is the best. Even though bichloride of mercury is an efficient germicide, one of the strongest known, and its use will most certainly destroy disease germs and prevent distribution of diseases, yet it must be admitted that it is not a very strong insecticide. In fact there is not known at this time any single chemical or substance or combination which possesses equal value as an insecticide and germicide and which would be suitable for disinfecting packing house equipment. For the time being it seems that bichloride of mercury is the best material that can be made use of for disinfecting field and packing house equipment.

State and Federal authorities are now, and have been, working to find a solution to this problem, that is, to find a combination of chemicals which will combine insecticidal and germicidal properties to such a degree as to insure the destruction of disease-causing organisms and also of mature and immature injurious insects. Such a combination to be of practical value must be one which will be cheap, easily obtained and used, harmless to boxes and other equipment as well as to the hands of the users. Considerable progress has been made in this work. It is hoped that in a comparatively short time announcement can be made of the results of these investigations.

It may be of interest to readers of this article to know that with the advancement of the idea of sanitary precautions in grove operations horticulturists of other states have become very much interested in the progress being made in Florida along these lines and it will not be surprising if, after it has been fully demonstrated that the use of these precautions is a practicable thing, other states and other communities will adopt their use. The Federal Government is working in very close cooperation with the State of Florida along these lines, and is watching with the closest attention the progress that is being made and the results obtained.

SOME IMPORTANT DISEASES OF SWEET POTATO*

By C. D. SHERBAKOFF
Associate Plant Pathologist, Florida Agricultural Experiment Station.

Sweet potatoes are of great importance in the agriculture of Florida, even at the present time. The crop is well adapted to the State's soil and climate and therefore should occupy an even more important position on our farms. In fact the profit from this crop could hardly be excelled by any other crop here if it were not for the different diseases to which this crop is commonly subject. Some of the diseases injure the plants in the field and thus reduce the yield; others attack sweet potatoes in storage and in that way further reduce the results of the harvest.

Both field and storage diseases are of about equally great importance to an individual grower and thereby to the State and country at large, yet most of the purely storage troubles affect directly only the grower without immediately threatening the industry or the community in which the grower extends his activities. When a soft rot destroys his sweet potatoes in the pit or storage house, the potatoes are lost. An entirely different thing takes place when sweet potatoes become affected with one of the important field troubles such as wilt or black-rot or foot-rot. In that case the disease not only causes more or less severe loss to the grower whose potato plants become affected with it, but his land, plants and seed will also be contaminated with the disease. Through their medium the trouble will be widely spread to every farm and garden into which will be brought such soil, plants or seed. The importance of this fact can be easily realized by any open-minded person when these two points are considered: (1) that under conditions favorable to any of these diseases practically every draw in a bed may become affected with one or all of them; and (2) that the effect, during an early stage of the disease, is often not very noticeable and thus the plants are regarded as being healthy. These diseased plants may, as it actually happens, be in hundreds of shipments sent out to farmers all over the State and thus these troubles are widely spread and jeopardize the industry.

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*Principal information in regard to the diseases discussed in this article are taken mainly from Farmers' Bulletin 714 on "Sweet-potato Diseases," by L. L. Harter.

Sweet potato growers, especially those who deal in sweet potato plants, should plainly understand at least this much: the disease, if not taken care of, will sooner or later get into their sweet potato beds and fields and thus directly cause to the growers considerable loss year after year and then eventually will ruin their reputation as sweet potato plant and seed producers. Another thing that should be considered in this connection is that all these important field diseases of the crop are, as it will be seen later in this article, comparatively easy to control and therefore no one really has any excuse for having them except an excuse based on either plain ignorance of the diseases and their control or on a manifest negligence of his plain duty to himself and to the community in and from which he makes his living.

Sweet potato diseases have been for quite a while under careful study by plant pathologists of some states, such as of Maryland, New Jersey and Virginia Experiment Stations and of the Bureau of Plant Industry, Department of Agriculture, Washington, D. C., and are at present well known in all their essential features, namely in their appearance, behavior and control. Any one looking for detailed information on these diseases may do well to obtain from these institutions bulletins on the subject. In fact, the writer believes that every sweet potato grower should have at least Farmers' Bulletin No. 714, which treats nearly all known sweet potato diseases and which may be obtained on request from the Bureau of Plant Industry, Washington, D. C.*

L. L. Harter in the Farmers' Bulletin just referred to, divides all sweet potato diseases into three groups. Field troubles attacking stems and underground parts of the plants, field troubles attacking sweet potato leaves, and storage rots.

LEAF DISEASES

Of the diseases affecting the leaves, on which they produce certain spots, at present none is known to be of sufficient importance to warrant special measures of control. Leaf-blight caused by the fungus *Phyllosticta batatas,* Leaf-spot caused by the fungus *Septoria bataticola,* and White-rust caused by the fungus *Albugo ipomoeae-panduranae,* are of common occurrence in nearly every sweet potato growing district. Because of their relative unimportance they will not be discussed here.

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*In that bulletin the care of sweet potato beds is discussed mainly from the point of view of conditions prevailing in middle Atlantic and Western states, where hot beds or at least cold frames are necessary for a sufficiently early production of the plants. The Florida grower fortunately does not need them and thus his difficulties in this connection are practically none.

STORAGE ROTS

usually destroy the greater part of sweet potatoes left in storage for winter and spring markets. There is no question that many more potatoes would be grown in this country if not for these rots which, under ordinary conditions, make the grower sell his potatoes too early in the season to realize the best price. This is so because under the conditions of almost absolute lack of measures to protect sweet potatoes against these rots it usually is safer and more profitable to sell all potatoes soon after harvest even at a very low price, than to store them and in consequence lose most of them during the storage and then sell what is left at a high price.

The following are well known storage rots of sweet potatoes: Soft-rot and Ring-rot, both caused by the common bread mold, *Rhizopus nigricans;* Black-rot, caused by the fungus *Sphaeronema fimbriatum;* Dry-rot, caused by the fungus *Diaporthe batatatis;* Java black-rot, caused by the fungus *Diplodia tubericola,* and Charcoal-rot, caused by the fungus *Sclerotium bataticola.* Of these rots, soft-rot and black-rot are most common.

SOFT ROT, as the name implies, produces a soft decay of potatoes. It starts at either end of the potato and in the presence of high humidity and at high temperature completely destroys it in a few days; such decayed potatoes while soft and watery at first, soon lose their moisture and become hard and brittle. If the potato skin be broken while the rotted potato is still in the soft stage then on the potato surface the fungus which causes this rot will produce its luxuriant moldy growth with a great mass of its spores. The mold is very common everywhere, grows readily on many decaying substances and is present in dust and on dirty boards, crates and so on. The rot gets into the potato through the ends where it was detached from the mother plant and through other injuries on its surface. The trouble is greatly favored by an abundance of moisture in and around the potatoes and by high temperature. Therefore to protect potatoes against this rot one should properly handle them from digging time to the end of the storage period. One should keep in mind that during digging and subsequent handling until placed in the storage, potatoes ought to be as little injured as possible; that in the field after digging and during the first two weeks of the storage they should be thoroughly cured, and that after that the temperature of the storage house should be comparatively very low.

To control soft-rot observe the following suggestions:

1. Dig the potatoes during bright, clear weather and allow them to thoroughly dry in the sun, without exposing them though to a too hot, scalding sun.
2. Place the dry dirt-free potatoes in open crates and then place them in the storage house in the crates. In this way the potatoes will have better ventilation, become less bruised than by dumping them into the bin and will be much easier to handle later on.
3. During the first two weeks the temperature of the storage houses should be high, namely from 80° to 85° F., and the house thoroughly ventilated to carry off moisture given off by the potatoes during this period of their curing. Then the temperature should be slowly lowered to from 50° to 55° F. During the remaining period of storage one should now and then examine the humidity of the house and give extra ventilation when necessary.

From the recommendation just given it is evident that for the safe storage of potatoes one should have an adequately built storage house, the temperature and moisture of which can be easily regulated.

There are some good plans available which show how to build a very simple and effective sweet potato storage house. A plan like this may be obtained on application either from the Florida Experiment Station, Gainesville, Florida, or from the Bureau of Plant Industry, Washington, D. C.

Sweet potatoes handled and stored in the way suggested to prevent soft-rot will in a great measure be protected also from other storage rots.

BLACK ROT is the other very important storage rot. It is caused by the same fungus as that which causes an important sweet potato trouble in the field, namely "Black-shank", and is discussed here later on under that disease.

FIELD DISEASES OF STEMS AND ROOTS

There are several field diseases affecting stems and roots of sweet potato plants. Of these, foot-rot, wilt, and black-shank are of great importance with us, and will be now discussed.

Foot-rot or Die-off. This disease affects sweet potato stems, roots and vines. It may start in the seed bed or in the field. On the stems it appears at first in the form of small brown to black spots which gradually extend, girdling the plants and progressing up the stems several inches; downward the trouble extends only a very short distance. The disease progresses somewhat slowly and hence affected plants begin to die off usually only late in the season. A severe case of the attack of this disease on sweet potato stems is shown in Fig. 83. After a time the diseased parts of the stem become covered with numerous, barely visible specks. These are fruiting bodies of the fungus, *Plenodomus destruens,* which causes the disease. The infection may extend down into the roots where it produces a firm brown rot as shown in figure 84. The surface of the rotted roots later on becomes also covered with numerous fruiting bodies of the

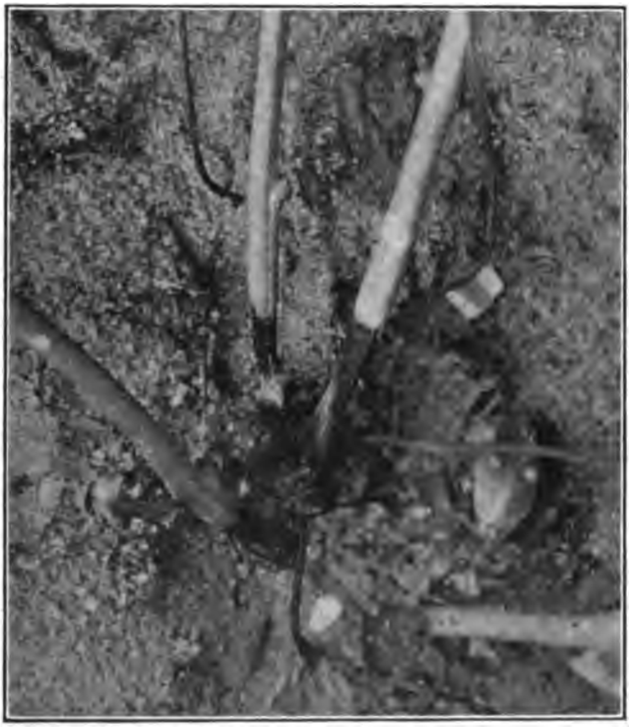

Fig. 83.—Sweet potato stems affected with foot-rot. The stems at their bases show dark brown rot typical for this disease. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

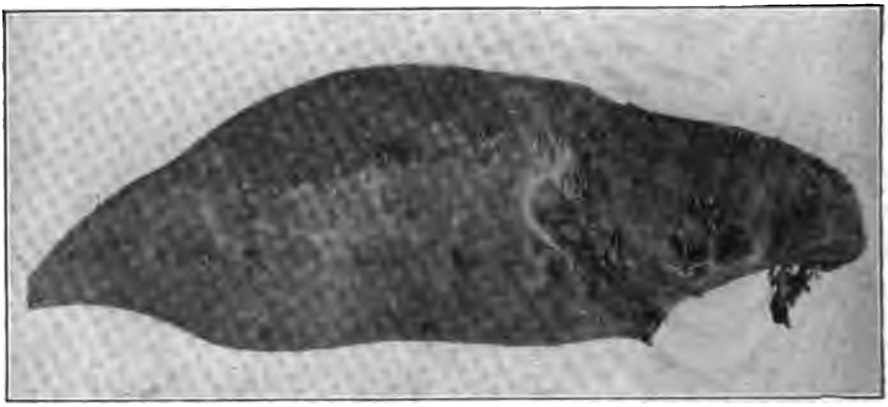

Fig. 84.—Sweet potato rotted at one end by foot-rot fungus. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

causal fungus which here appear in the form of minute pimple-like structures.

Usually the fungus invades only underground parts of the plant but during a rainy season and with a rank growth of the plants, the vines frequently become also attacked. In this case the rot extends sometimes for a considerable distance each way from the starting point.

Usually no potatoes are produced in the hills attacked with this disease. Foot-rot is known to occur in Florida and in several other states and it seems that the trouble eventually will be found everywhere where sweet potatoes are grown. This will happen, of course, if its further spread is not prevented.

The damage caused by the disease often amounts to more than half of the crop. The disease is distributed through seeds and plants and old vines contaminated with the fungus. The means of distribution of the fungus should be remembered because on this knowledge are based the methods of control.

To control foot-rot. Use only carefully selected seed. No potato showing any sign of rot should be used as seed. Just before bedding the seed potatoes they should be disinfected by soaking them for ten minutes in a solution of corrosive sublimate of 1:1000 strength. To make this solution, dissolve 1 ounce of corrosive sublimate, crystals, in 8 gallons of water. The same solution can be used over again three times, then it should be discarded and a new solution made if more seed needs to be treated. Corrosive sublimate is an extremely strong poison and should be handled in such a way as to insure that neither human beings nor farm animals or birds get a drink of the solution. It is not poisonous to the skin and thus hands wet with it

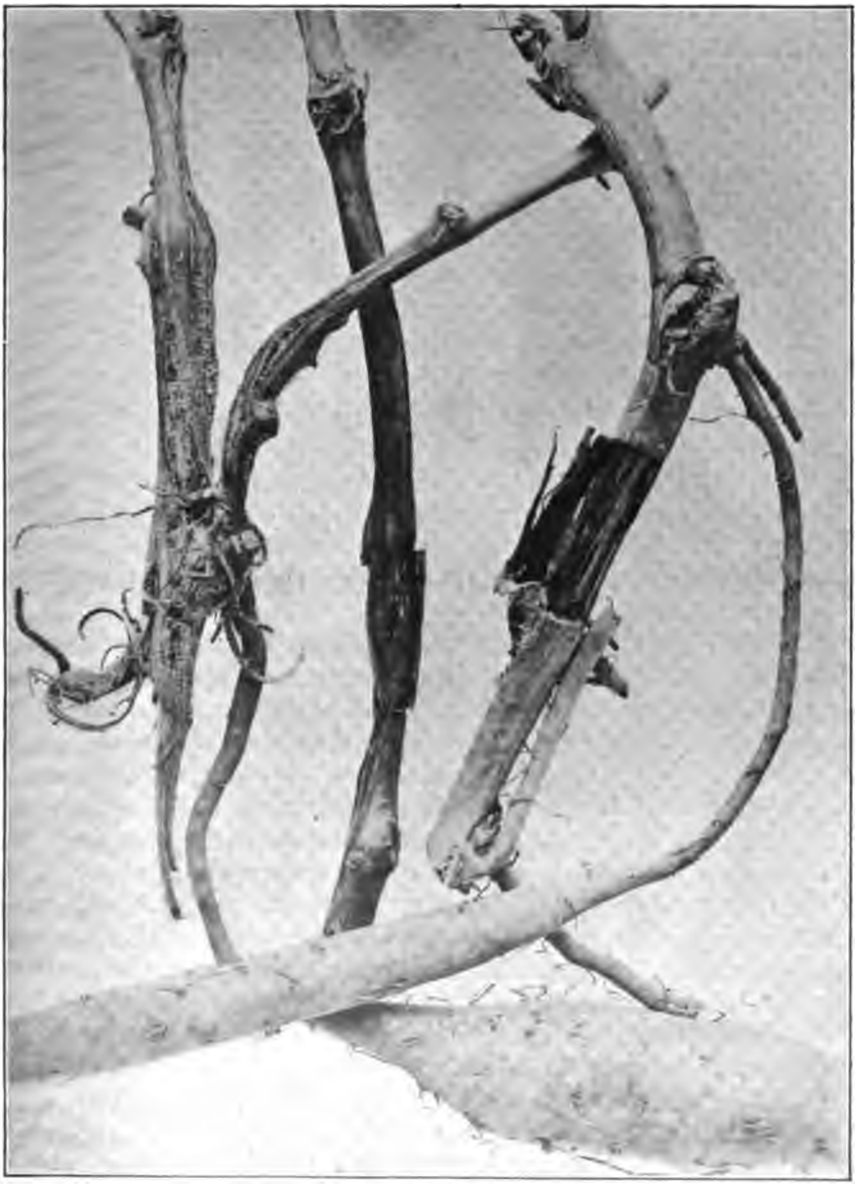

Fig. 85.—Sweet potato stems affected with wilt, also known as stem-rot. The stem on left shows split condition and spindling root; the other two stems show darkened interior tissues when the bark is removed. (After J. A. McClintock, Va. Truck Exp. Station, Bul. 22.)

are not injured. It corrodes metals and therefore should be handled in wooden, glass or earthenware containers.

Make sweet potato beds somewhere in the woods on a virgin soil or at least on a soil new to sweet potatoes.

Don't use, for the beds or in the field, old sweet potato vines or manure mixed with them.

In the field plant sweet potato plants either in a new soil or in a soil which has not been used for this crop for at least three preceding years.

WILT OR STEM-ROT, YELLOW BLIGHT, BLUE STEM. The disease can be detected at first by a dull and then yellow color and puckered appearance of the leaves; later by wilting of the plants and rupturing, blackening and rotting of the stems (see Fig. 85). A faint purple tint can be seen through the white of the young plants infected with the trouble. Stems infected with the trouble will, on splitting, always show a distinct blackening inside. This blackening may extend in the vines for several feet and is a sure sign of the disease.

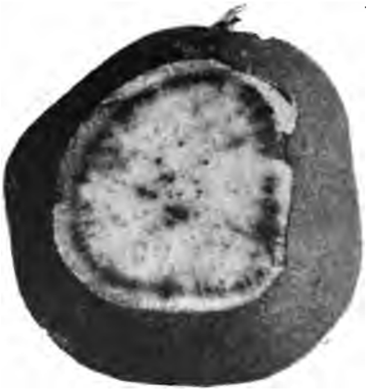

Fig. 86.— Sweet potato with one end cut off to show internal discoloration due to stem-rot fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

This blackening often extends also into the potatoes as can be seen in Fig. 86. Such potatoes when bedded often produce plants that will also be diseased.

The disease is very destructive and, in certain cases, is known to kill nearly every plant in the field. According to L. L. Harter (see bulletin cited, p. 6), "at the most conservative estimate stem-rot is responsible for a loss of at least three-quarters of a million dollars annually to the sweet potato crop in the United States."

It is caused by two very closely related fungi, *Fusarium batatatis* and *Fusarium hyperoxysporum*. Though these fungi are also closely related to those causing wilts of other crops such as cotton, watermelon and tomatoes, they, so far, are not known to cause wilt of other crops.

At present the disease is known to occur in Florida and in many other states.

Control of wilt or stem-rot in all respects is the same as that of foot-rot except that a bin selection of the seed cannot be successful against this trouble. Sorting out potatoes from storage is not effective because the presence of the wilt fungus in them cannot be detected by any external symptom. Potato seed should be selected in the field shortly before digging time, but when the vines are still alive. This selection should be arranged in the following way: 1, select for seed purposes, a best yielding, uniform in all respects and most healthy looking field or part of a sweet potato field of a sufficient size; 2, go through every row of the seed patch and examine for wilt at least two vines from each hill. For this examination the vines must be cut off close to the point of their origin, that is where they began to grow from the draw or from the originally planted vine; these vines should then be split lengthwise and the inside color noted; wilt-affected vines will always show a distinct darkening. 3, every hill, vines of which on such examination showed darkening inside, and also every hill having any abnormal color of the leaves or prematurely dead vines, should be staked off during the examination for the wilt. 4, potatoes from the staked off hills should be dug out separately and before digging the entire seed patch so that they will not be mixed

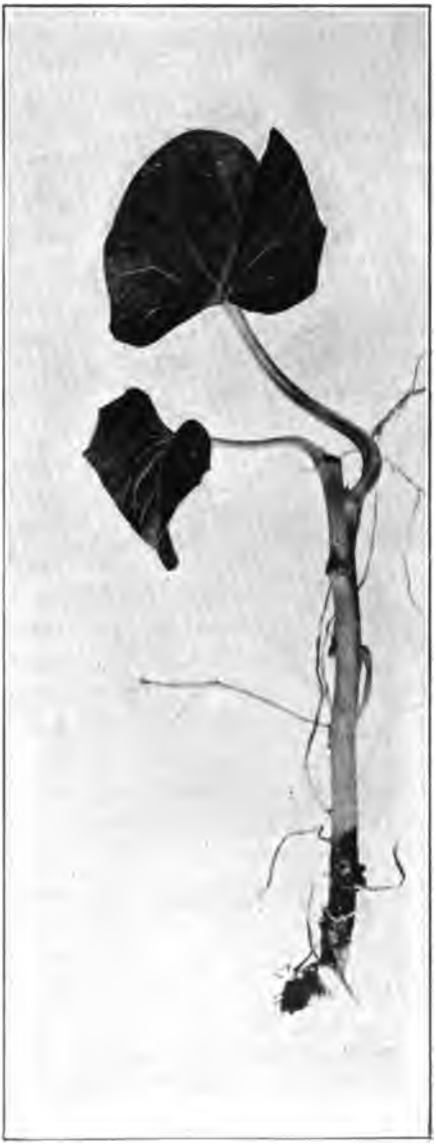

Fig. 87.—Small sweet potato plant showing blackening of its underground basal part, due to black-shank fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

with seed potatoes. The former may be used in any way, of course, except for seed. 5, the seed potatoes remaining in the seed patch should be dug at the regular time and manner except that naturally special care must be observed in handling and storing them.

Just before bedding the potato seed, sort them over, disinfect and so on in the same way as recommended for the control of foot-rot.

BLACK-SHANK OR BLACK-ROT. This disease affects any underground part of sweet potato plants. On the draws it appears at first in the form of small, black spots as shown in Fig. 87. The spots in time enlarge and cause rotting off of the entire plant. On the potatoes it produces dark to nearly black, somewhat sunken, spots (see Fig. 88) with a metallic luster on the surface and greenish tissue beneath. The spots at first are small but often they may extend until the whole potato is rotted. Potatoes affected with black-rot when cooked have a very disagreeable taste and therefore should never be sold for human consumption; a few potatoes of this kind tasted by a consumer will surely turn him from this food product and thus the market will be greatly injured. Neither should such potatoes be used for seed because they will produce plants which most likely will also be affected with the disease.

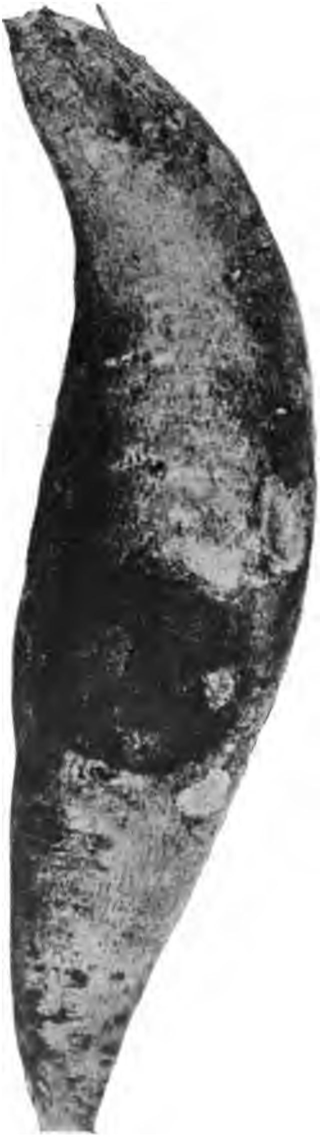

Fig. 88.—Sweet potato showing a round spot due to black-shank, also known as black-rot fungus. (After L. L. Harter, U. S. Dept. of Agr., Far. Bulletin 714.)

Black-shank causes considerable damage in the seed bed and in the field by attacking draws, vines and roots; it also causes one of the most important storage rots, black-rot. On the whole, according to L. L. Harter, the disease causes a loss throughout the country "probably equal to that of all other diseases combined."

Black-shank (black-rot) is caused by the fungus *Sphaeronema fimbriatum,* which is distributed in about the same way as the fungus causing foot-rot and is controlled in the same way as the last named disease.

SUMMARY OF CONTROL OF IMPORTANT FIELD DISEASES

1. Fall selection of sweet potato seed free from wilt (see details under wilt).
2. Sorting and disinfection of seed potatoes just before bedding them.
3. Locating sweet potato beds in a virgin soil or soil new to this crop.
4. In the field rotate sweet potatoes with some other crops in such a way that sweet potatoes will not be planted in the same field oftener than once in four years.
5. Destruction of old potato vines or composting them and using for fields that are not to be used for sweet potato for at least three years hence.

CONCLUSION

In conclusion of this brief discussion of some most important sweet potato diseases it should be most emphatically stated that these diseases are chiefly responsible for most of the crop failures; that they, if not controlled in time, will become present in every field which is more or less regularly used for the culture of the crop, and that thus eventually will make the difficulties of cultivation manifoldly greater and the culture itself probably hardly profitable at all. But if the grower will follow the suggestions given for control of these diseases, and simultaneously pay due attention to the proper selection of sweet potato seed for higher yields and for better and more uniform types of potatoes, he will soon realize how much all this is to his own immediate profits and in that way, of course, to the benefit of the whole community.

TERMITE INJURY TO SWEET POTATOES

E. W. BERGER

Owing to the great importance of the sweet potato weevil, *Cylas formicarius* Fab., sweet potato growers should be on the

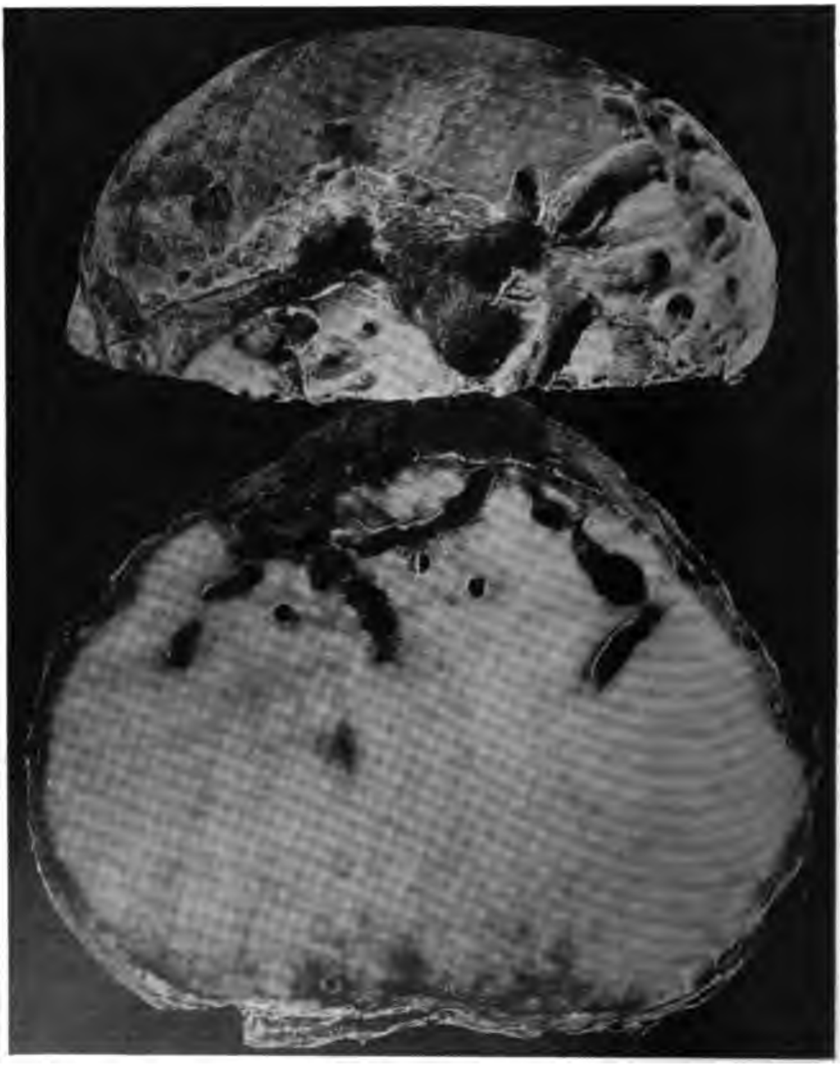

Fig. 89.—Sweet potato tuber showing tunnels by termites. Upper figure from outside; lower in cross section. Upper figure is top view of piece cut from potato to get section shown in lower figure. Natural size. (From a photo by E. W. Berger.) Compare with photo of injury by sweet potato root weevil, Fig. 72, Vol. II, No. 1, Oct., 1917.

watch for it everywhere and especially in sections supposed to be free from the pest.

Among injuries most likely to be confused with the work of the sweet potato weevil are those caused by termites or "white ants". Injury by these insects to tubers is well illustrated by Figure 89. Comparison of this figure with Fig. 72, published on pg. 87 of the Quarterly Bulletin for October 1917, Vol. II, No. 1, will make several differences apparent:

1. Absence of larvae (grubs) and pupae in the tunnels when infested by termites, but their presence in apparent abundance when the tuber is infested with the weevil.

2. Absence of frass (excreta) when the injury is due to termites, but an abundance of this in the tunnels produced by the weevil.

3. Exit and entrance holes very apparent with termites, but tuber infested with weevil may show little or no outward evidence of its condition inside.

4. The clean-cut outlines of the tunnels made by the termites are in marked contrast with those made by the weevil.

Besides the differences indicated in the illustrations, several other facts of use in determining the presence of the weevil or termites may be noted:

5. If the plants are growing, tunneling larvae (grubs) in the stems near the ground indicate the weevil.

6. The presence of large (about ¼ in. long) ant-like insects with black heads and snout, brick-red thorax (middle) and legs, and dark steel-blue hind end, is an almost certain sign of the weevil.

7. The presence of whitish rapidly running insects, having much the appearance of ants, indicates termites.

DEPARTMENT OF CITRUS CANKER ERADICATION

REPORT ON ERADICATION WORK FOR QUARTER ENDING JUNE 30, 1918

The following report on the canker eradication work, conducted in co-operation with the Bureau of Plant Industry, U. S. Department of Agriculture, during the three months ending June 30, has been compiled by Mr. Frank Stirling, General Inspector:

QUARTER ENDING JUNE 30, 1918

Citrus grove trees inspected	2,299,163
Citrus nursery trees inspected	14,043,857
Inspectors employed	220
New properties showing infection	2
Total properties showing active infection	6
Grove trees found infected	13
Nursery trees found infected	0
Counties in which active infections were found	4

GENERAL SUMMARY

Florida counties in which canker has been found	22
Grove trees found infected since May, 1914,	13,723
Nursery trees found infected since May, 1914,	342,254
Number properties infected to June 30, 1918,	479
Properties declared no longer "danger centers"	432
Properties still classed as "infected" June 30, 1918,	47

The following table shows the number of citrus grove trees found infected with canker during each month from the beginning of the eradication work to June 30, 1918:

1914		1915		1916		1917		1918	
		Jan.	306	Jan.	86	Jan.	14	Jan.	0
		Feb.	165	Feb.	21	Feb.	4	Feb.	1
		Mar.	444	Mar.	49	Mar.	9	Mar.	1
		Apr.	408	Apr.	49	Apr.	169	Apr.	2
May	108	May	1042	May	338	May	52	May	1
June	160	June	772	June	450	June	45	June	10
July	275	July	651	July	349	July	39		
Aug.	1313	Aug.	1345	Aug.	219	Aug.	30		
Sept.	767	Sept.	618	Sept.	124	Sept.	6		
Oct.	565	Oct.	214	Oct.	451	Oct.	2		
Nov.	773	Nov.	494	Nov.	131	Nov.	1		
Dec.	366	Dec.	256	Dec.	27	Dec.	1		

QUARANTINE DEPARTMENT*

REPORT FOR QUARTER ENDING JUNE 30, 1918.

The following reports on the inspections of shipments and importations, all ports and stations, have been compiled by Mr. K. E. Bragdon, Assistant Quarantine Inspector:

PORT AND RAILWAY INSPECTION

SHIPS AND VESSELS INSPECTED:			
From foreign ports	475		
From U. S. ports other than Florida	273		
From Florida ports	200		
Total		948	
SHIPMENTS INSPECTED:			
Arriving by water:			
Passed	1868		
Treated and passed	18½		
Returned to shipper	37		
Detained, subject to return by shipper	0		
Contraband destroyed	300½		
		2224	
Arriving by land—Express, Freight, Wagons, etc.:			
Passed	302		
Treated and passed	27		
Returned to shipper	45		
Detained, subject to return by shipper	25		
Contraband destroyed	12		
		411	
Total shipments inspected			2635

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or Disease	Occurring on	From	No. of parcels infested
Aphis sp.	Rose	Connecticut	3
Aphis sp.	Rose	Cuba	1
Aspidistra scale	Fern	Georgia	1
Aspidistra scale	Hibiscus	Florida	1
Aspidistra scale	Sour sop	Cuba	1
Bephrata cubensis	Sour sop	Cuba	3
Black scale	Grape	Ohio	1
Chaff scale	Citrus	Cuba	1
Chaff scale	Palm	Georgia	1
Chaff scale	Sour sop	Cuba	1
Cocoanut mealy-bug	Avocado	Florida	1
Coffee-bean weevil	Coffee	Brazil	1
Corn weevil	Corn	Mexico	1
Crown gall	Geranium	Massachusetts	1
Crown gall	Peach	Georgia	1
Crown gall	Raspberry	New York	1

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*By action of the State Plant Board, taken on May 10, 1918, the name of the "Port and Railway Inspection Department" was changed to that of "Quarantine Department". The latter Department, as now organized, includes the parcel post inspection, control and eradication of sweet potato weevil and eradication of the banana root borer. Problems involving essentially quarantine measures will come within the province of this Department.

Insect or Disease	Occurring on	From	No. of parcels infested
Dictyospermum scale	Cocoanut	Cuba	1
Dictyospermum scale	Jasmine	Cuba	1
Florida red scale	Palm	Florida	1
Florida red scale	Rose	Cuba	1
Hemisphaerical scale	Palm	Massachusetts	1
Hemisphaerical scale	Sour sop	Cuba	1
Hemisphaerical scale	Unknown plant	Florida	1
Leaf hopper	Cotton	Spain	1
Long scale	Citrus	Cuba	1
Long-tailed mealy-bug	Hibiscus	Florida	1
Long-tailed mealy-bug	Unknown plant	Florida	1
Mealy-bug	Coleus	Maryland	1
Mealy-bug	Coleus	Ohio	1
Mealy-bug	Sour sop	Cuba	1
Nematode root-knot	Blackberry	North Carolina	1
Nematode root-knot	Fig	Florida	1
Nematode root-knot	Grape	Texas	1
Nematode root-knot	Peach	Georgia	1
Nematode root-knot	Rose	Florida	1
Oyster-shell scale	Snowball	Pennsylvania	1
Phyllocoptes sp. (mite)	Cereus	Mexico	1
Pseudoscorpion	Citrus	Spain	1
Psocus sp.	Sour sop	Cuba	1
Purple scale	Boxwood	Georgia	1
Purple scale	Citrus	Cuba	2
Pustule scale	Holly	Florida	1
Pyriform scale	Honeysuckle	Florida	1
Red bay scale	Jacob's ladder	Florida	1
Red bay scale	Magnolia	Florida	1
Rose slug	Rose	Connecticut	1
San Jose scale	Cherry	Massachusetts	1
San Jose scale	Currant	Massachusetts	1
San Jose scale	Currant	Ohio	1
San Jose scale	Hydrangea	Massachusetts	1
San Jose scale	Peach	Massachusetts	1
San Jose scale	Peach	Ohio	1
San Jose scale	Plum	North Carolina	1
San Jose scale	Plum	Ohio	1
Soft brown scale	Fern	Massachusetts	1
Soft brown scale	Palm	Florida	1
Soft brown scale	Sour sop	Cuba	1
Sweet potato weevil	Sweet potato	Cuba	2
Thrips	Rose	Connecticut	1
Tortoise beetle	Guava and citrus	Cuba	1
Tussock moth	Unknown plants	Massachusetts	1
Walnut scale	Cherry	Massachusetts	1
Walnut scale	Currant	Massachusetts	1
Walnut scale	Peach	Massachusetts	1
Walnut scale	Peach	South Carolina	1
Whitefly	Jasmine	Florida	1

PARCEL POST PLANT INSPECTION

PARCELS INSPECTED:		
Passed	3193	
Treated and passed	68	
Returned to sender	6	
Detained, subject to return by sender	1	
Infested or infected parcels destroyed	0	
Total parcels inspected		3268

PRINCIPAL PESTS AND DISEASES INTERCEPTED

Insect or disease	Occurring on	From	No. of parcels infested
Crown gall	Rose	Ohio	3
Florida red scale	Citrus	Florida	1
Florida red scale	Ivy	Florida	1
Melanose	Citrus	Florida	1
Nematode root-knot	Geranium	Ohio	2
Nematode root-knot	Hibiscus	Ohio	3
Nematode root-knot	Lemon verbena	Ohio	1
Nematode root-knot	Petunia	Ohio	1
Nematode root-knot	Plumbago	Ohio	1
Nematode root-knot	Rose	Ohio	59
Nematode root-knot	Rose	Georgia	1
Nematode root-knot	Wistaria	Ohio	1
Palmetto scale	Palmetto	Florida	1
Pustule scale	Holly	Florida	1
Soft brown scale	Cape Jasmine	Florida	1
Soft brown scale	Cut flowers	Florida	1
Soft brown scale	Ivy	Florida	1
Whitefly	Cut flowers	Florida	3

THE QUARTERLY BULLETIN

State Plant Board of Florida

DEVOTED TO APPLIED ENTOMOLOGY AND PLANT PATHOLOGY IN GENERAL, WITH SPECIAL REFERENCE TO THE PREVENTION, CONTROL AND ERADICATION OF INJURIOUS INSECTS AND PLANT DISEASES IN FLORIDA.

Sent free to all citizens of Florida. Offered in exchange for publications of the Federal and foreign governments and experiment stations, entomological and mycological journals, agricultural and horticultural papers and other publications of a similar nature.

WILMON NEWELL, *Plant Commissioner*........*Editor*

ASSOCIATE EDITORS.

E. W. BERGER........*Entomologist*
F. M. O'BYRNE........*Nursery Inspector*
FRANK STIRLING........*General Inspector*
J. H. MONTGOMERY........*Quarantine Inspector*
H. E. STEVENS........*Consulting Plant Pathologist*

Entered as second-class matter November 14, 1916, at the postoffice at Gainesville, Florida, under the Act of June 6, 1900. Acceptance for mailing at special rate of postage provided for in Section 1103, Act of October 3, 1917, authorized July 10, 1918.

The following editorial by David B. Mackie, taken from the June, 1918, issue of the Monthly Bulletin of the California State Commission of Horticulture, describes all too well a condition which even Florida has experienced in times past and a condition which, in the aggregate, has cost the United States countless millions of dollars. Fortunately, the citrus growers and members of the Florida legislature have, during recent years, proven themselves exempt from the narrowness of viewpoint which is illustrated in this editorial. It is to be devoutly hoped that the broad viewpoint and foresight which made possible the, to date, successful campaign against citrus canker will characterize the deliberations of our Florida statesmen and citizens when serious situations are confronted in the future:

"WHERE DOES THE BLAME BELONG? From Australia comes the report that citrus canker has made its appearance in the commonwealth. True to tradition, the uninformed public through the press does not hesitate to jump to the horticultural officers and lay the blame for allowing the importation at their door.

"This is in a large measure to be expected. These officials furnish a convenient object for attack at this time when a certain amount of invective must be expended.

"Not being in a position to state with authority on whom devolves the responsibility for allowing the introduction of canker into Australia, but having had a certain amount of experience in securing and enforcing horticultural legislation, speaking in the abstract it should be stated that there are many aspects of such problems that are seldom brought to the notice of the public.

"The assertion is ventured that there are, among those who will read this article, horticultural officials who have had a chance to wear themselves out trying to squeeze from a reluctant legislature funds for the purpose of providing a means of preventing the introduction of some plant pest or disease that may be causing consternation in some other part of the world and which it is realized will sooner or later be brought to their shores. Nor is the legislature entirely to blame. Such bodies as a rule are generally composed of individuals largely ignorant of the bionomics of insect pests and plant diseases, without training in the estimation of evidence in this line, and withal unable to appreciate the extent or imminence of danger which may be anticipated from this source. The responsibility may often be traced farther back to the fruit growers themselves, who, with full knowledge of the true significance of the menace, adopt the let-George-do-it attitude and wait for someone else to take the initiative. There may be meetings held and resolutions prepared but concerted action and a follow-up policy are largely lacking. Interest wanes until the eleventh hour when the pest in question appears and their chance has vanished. This attitude is particularly reprehensible as they must surely understand fully that whatever happens they will be the losers.

"As a result of this combination of circumstances pleas for preventive rather than remedial measures too often receive a deaf ear and the matter is often viewed from the standpoint that the originator of these measures is either exceedingly hard up for something to do or else desires to distribute a little political patronage. Whatever the reason, the results are always the same. In tracing the course of introduced plant pests and diseases it is an unwritten law that the government which has failed to take necessary precaution in providing adequate means to prevent the introduction of undesirable alien plant pests and diseases sooner or later, but nevertheless surely, has an opportunity to 'chew the cud of bitter reflection' and dig down into its coffers to the extent of about one hundred times the amount a proper insurance against this class of undesirable aliens would have cost.

"It may seem a far cry, but perhaps some day it will be recognized that any insect or pathogenic organism which utilizes as a host some particular plant, no matter in what part of the world that host plant may exist, without proper protective measures, becomes in this day of modern transportation facilities a potential pest throughout the entire region where such plant may be grown.

"California has had an opportunity to view the case in its different aspects. The price of her knowledge has been the alternative between destruction of her citrus industry or the annual expenditure of large sums of money to keep under control a host of these introduced enemy aliens brought into her midst before the potentialities of such things began to be appreciated. Viewing her experiences in retrospect, she now purchases insurance against their further introduction, these by a judicious system of quarantines and a trained inspection service exceeded by none and equalled by few. It is believed that a few pages taken from the experiences of our state will well repay the trouble."

THE DELAY IN GETTING OUT THIS NUMBER of the Quarterly Bulletin is keenly regretted by the editors. It should have appeared not later than July 15th.

It is customary in these times to charge the Hun with most calamities, upset plans and inconvenient happenings, and so in the present instance we must charge the Hun and his allies, the black fly and the semi-tropical army worm, with our troubles.

As will be noted from the "Honor Roll" on the first pages of this issue, 68 of the Plant Board's trained inspectors are either "over there" or getting ready to go over shortly. New men have not been employed to take the place of these absent inspectors, but the work of the Plant Board has, through the earnest and untiring efforts of its employees remaining, continued on as large a scale as ever and, we hope, as efficiently. Not only has the canker eradication work been pushed with vigor and apparent success but an active campaign to eradicate the banana root borer has apparently been successful and much has been accomplished in restricting the spread of the sweet potato weevil.

The editor was obliged to be in Cuba during the early days of July in connection with investigations of the black fly, that we may the more effectively protect Florida from this enemy, and during the latter part of July severe outbreaks of the semi-tropical army worm in several Florida counties required the undivided attention of our force to the end that many thousands of acres of castor beans might be saved from destruction. To the Hun and these allies of his, the delay in preparing this issue is certainly due. We let it go at that. (August 3, 1918.)

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